Draft environmental impact statement and environmental assessment, proposed plan of mining and

DRAFT

MONTANA DEPARTMENT OF STATE LANDS

ENVIRONMENTAL IMPACT STATEMENT

AND

BITTERROOT NATIONAL FOREST

ENVIRONMENTAL ASSESSMENT REPORT

PROPOSED PLAN OF

MINING AND RECLAMATION

WESTERN VERMICULITE COMPANY

RAVALLI COUNTY, MONTANA

DECEMBER 28, 1978

MONTANA DEPARTMENT OF STATE LANDS

U.S. DEPARTMENT OF AGRICULTURE

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ENVIRONMENTAL ASSESSMENT

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WESTERN VERMICULITE COMPANY

RAVALLI COUNTY, MONTANA

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Montana Department of State Lands

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INTRODUCTION

Preface

This statement was prepared by the U.S. Forest Service (Bitterroot National Forest) and the Montana Department of State Lands (lead state agency) and represents a joint analysis of cumulative environmental impacts of a proposed vermiculite mine development by Western Vermiculite Incorporated, in an area near Hamilton in Ravalli County, Montana.

On April 14, 1977, Western Vermiculite submitted to the Bitterroot National Forest (USFS) a notice of intent to conduct mining operations for the development of the ABM Ridge vermiculite ore deposit in the Sapphire Mountains east of Hamilton, Montana.

On January 17, 1978 Western Vermiculite filed a hard rock operating permit application with the Montana Department of State lands (Department). Western Vermiculite was notified by the Department that additional information was necessary for a complete operating permit application. Recognizing that at that time (1) the regulations pursuant to the Hard Rock Law required that a hard rock operating permit must be granted or denied within 60 days following the receipt of a complete application and that (2) the project was of a controversial nature and major scope, the Department entered into negotiations with Western Vermiculite and requested an extension of the 60 day time period.[1]

In June 1978, the Department and the USFS agreed to participate jointly in the preparation of a environmental impact statement for the Western Vermiculite project. Work on the EIS commenced July 1, 1978.

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[1]Prior to passage of an amendment to the Hard Rock Act by the 1977 Legislature (HB 1977) in which the 60-day time period for departmental action on a complete hard rock operating permit application was changed to a negotiable period of one to 365 days in addition to the initial 60-day time period.

Agency Responsibilities and Interagency Relationships

Responsibilities of Montana State Agencies

Department of State Lands

The Montana Board of Land Commissioners[1]/(Board) and Montana Department of State Lands[2]/(Department) are responsible for the administration of the Montana Hard Rock Law (Title 50, Chapter 12, R.C.M. 1947).

Section 2 (50-1202) states:

> *The purposes of this act are to provide: (i) that the usefulness, productivity and scenic values of all lands and surface waters involved in mining and mining exploration within the boundaries and lawful jurisdiction of the state will receive the greatest reasonable degree of protection and reclamation to beneficial use; (ii) authority for cooperation between private and governmental entities in carrying this act into effect; (iii) for the recognition of the recreational and aesthetic values of land as a benefit to the state of Montana; and (iv) priorities and values to the aesthetics of our landscape, waters and ground cover . . .*

Pursuant to its duties as administering agency for the Hard Rock Law, the Department must review and then grant or deny a hard rock mine permit or permit amendment within a period negotiable with the applicant to be not less than 60 days, nor more than 425 days after the submission of a complete permit application. The department reviews applications for conformance with provisions of the Hard Rock Law regarding the method of operation, water control, air quality, mine waste disposal, topsoiling and for the reclamation of lands affected by the proposed mining operations. A hard rock mining permit requires the operators

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1/ The Board of Land Commissioners consists of the Governor, Attorney General, Superintendent of Public Instruction, State Auditor and Secretary of State.

2/ The Commissioner of State Lands is the chief administrative officer for the Department of State Lands and is appointed by and serves at the pleasure of the Governor.

to provide for the reclamation of mined land. A bond of $200 to $2,500 per acre must be filed with the Department. A contract may be enforced through forfeiture of bond or criminal penalties.

The Board may adopt rules to accomplish the purpose of the Hard Rock Law, and the Department may adopt rules with respect to the filing of reports and the issuance of permits. To insure compliance with the Hard Rock Law and rules adopted pursuant to the Law, the Department is required to make mine inspections and investigations as necessary.

Provisions for denial of a hard rock mining permit are specified in Section 50-1214 of the Hard Rock Law. The Department may conduct studies of hard rock mining and hard rock mining land reclamation.

When the operator is not in compliance with requirements of the Hard Rock Law, rules pursuant to the law, or orders of the Department and has not achieved compliance within time limits set by the Department, the commissioner shall serve a notice of noncompliance on the operator, or if necessary, he shall order the suspension of the permit. After a hearing, the Board shall order the Department to revoke the permit if requirements specified in the notice of noncompliance, in the order of suspension, or if an order of the Board requiring remedial measures have not been satisfied.

Montana Department of Health and Environmental Sciences

The Air Quality Bureau of the Department of Health and Environmental Sciences has primary responsibility for air pollution control activities in the state of Montana. These responsibilities include the review of new sources of air pollution to be located in the state, enforcing standards, and ensuring that Federal Standards are achieved and maintained.

The Montana Clean Air Act (Chapter 39, Title 69, R.C.M., 1947) provides rule making authority to the Board of Health in regard to permits (Section 69-

3911). This rule making authority was exercised by the adoption of rule MAC 162.14(7) S1400, Permits, Construction and Operation of Equipment. This rule provides that prior to the construction or operation of any new or modified equipment of certain categories, a permit be otained from the Department of Health, Air Quality Bureau. Therefore, the Board of Health may prohibit:

> *. . . the construction, installation, alteration or use of any machine, equipment, device or facility which it finds may directly or indirectly cause or contribute to air pollution or which is intended primarily to prevent or control the emission of air pollutants, unless a permit therefore has been obtained from it.*

In addition to the permit required, one facility of the ~~department~~ COMPANY will be subject to certain emission standards as contained in the Administrative Records of Montana. The primary regulated source would be the crusher, and the emissions of most concern are that of particulate matter.

The Air Quality Bureau is also charged with achieving and maintaining both state and federal ambient air quality standards. The Montana State Implementation Plan describes the states efforts in achieving and maintaining federal ambient air quality standards. One requirement of this plan is that it provide for the achievement and maintenance of federal primary ambient air quality standards by 1975 and for achievement and maintenance of secondary standards as soon thereafter as is practicable. In many areas of the state, the strategies to achieve the standard have not accomplished the desired result, i.e., achievement of the standard, but such achievement remains a primary goal of the agency.

Relationships among state Agencies

Two State agencies, the Department of State Lands and the Department of Health and Environmental Sciences, have decisions to make in regard to the Western Vermiculite Company proposal that require environmental review under the Montana Environmental Policy Act. The Department of Fish and Game does not have a decision to make

which requires review under MEPA, but is cooperating in the preparation of this impact statement to help anticipate and solve possible problems in regard to Western Vermiculite Company's proposal.

Responsibilities of and Relationships Between Federal Agencies

Forest Service - B.L.M.

Responsibilities of the Forest Service

The responsibility for managing the mineral resources relating to the General Mining Law of 1872 is with the Secretary of the Interior. The Bureau of Land Management has redelegated certain functions of the administration of mining claims on National Forest System lands to the Forest Service. The Forest Service administers these claims under Regulations 36 CFR parts 251, 252, and 293, which cover prospecting, exploration and mining activity on the National Forest System by persons operating under the United States Mining Laws of May 10, 1872, as amended (30 USC 22).

The 1872 General Mining Laws and its principal amendment of July 23, 1955 allows any prospector, who discovers what he believes to be a valuable mineral deposit on "public domain" National Forest, to locate and work a mining claim. The Organic Administration Act of 1897 states that persons have statutory rights, not a mere privilege, to enter upon national forests for the purposes of prospecting and mining. These rights cannot be unreasonably restricted or made excessively burdensome.

Since 1872, laws have been passed by Congress that affect, but do not diminish, the rights granted the miner under the General Mining Law. These are:

1. The Antiquities Act of 1906 (34 Stat. 1255).
2. The Multiple Use Mining Act of 7/23/55 (69 Stat. 367).
3. The National Historic Preservation Act of 1966 (30 Stat. 915).
4. The National Environmental Protection Act of 1/1/70.
5. The Clean Air Act (42 USC 1857).

6. The Federal Water Pollution Control Act of 1972 (33 USC 1151).

7. The Solid Waste Dispoal Act (42 USC 3251-3259).

8. The Rare and Endangered Species Act of 12/28/73 (18 Stat. 884).

9. The Federal Land Policy and Management Act of 10/26/76 (90 Stat. 2243).

United States Department of Agriculture Rules on Prospecting, Exploration and Mining procedures (effective 9/1/74) set forth rules and procedures to minimize adverse environmental impacts on national forest surface resources. However, these rules do not provide for the management of mineral resources. Such responsibility lies with the Department of Interior.

The Western Vermiculite Company's proposal consists of 58 unpatented mining claims. Rights on unpatented mining claims are split, with the mining companies having the mineral rights and the Forest Service the surface rights.

The surface rights on unpatented mining claims are managed under the U.S. Department of Agriculture Rules for National Forest Surface Use under U.S. Mining Laws (Title 36 CFR, Section 252.1-252.15). Facility location, construction and operation are administered under the rules governing (Section 252.4), approval of operating plans (Section 252.5), Inspection (Section 252.7), Requirements for environmental protection (Section 252.8), Maintenance during operations (Section 252.9), and access (Section 252.12). Bonding of the operation as well as project cessation and reclamation are covered in Sections 252.13 and 252.10.

The objective of the Forest Service is to integrate the development and use of mineral resources with the use and conservation of all other forest resources to the fullest extent possible under the laws governing mineral disposal. This embodies the concept of multiple use in its broadest sense.

Forest Service policy is:

1. In managing the use of the surface and surface resources, the Forest Service should attempt to minimize or prevent, mitigate, and repair adverse environmental

impacts on National Forest System surface resources as a result of lawful prospecting, exploration, mining, and mineral processing operations, as well as activities reasonably incident to such uses. This should be accomplished by imposition of reasonable conditions which do not materially interfere with such operations.

2. The primary means for obtaining protection of surface resources should be by securing the willing cooperation of prospectors and miners. The willingness of the majority of prospectors and miners to comply with reasonable regulations, reasonably administered, is a principal key to the protection of environmental quality in the National Forst System. Face-to-face dialogue with operators is encouraged.

However, legal remedies are available. The Forest Service will consider seeking judicial relief for operations that are unnecessarily or unreasonably causing, or threatening to cause irreparable injury, loss, or damage to surface resources. A court may grant injunctive or mandatory relief, and award damages to the extent of the value of the property damaged. Also, there may be other remedies for violation of Federal and State standards for air and water quality and for the disposal of solid wastes.

The Forest Service is not authorized to manage locatable mineral resources in National Forest System lands. The Forest Service is, therefore, not directily concerned with methods and techniques of prospecting, exploration, mining or mineral processing, except to the extent that certain methods and techniques can have greater or lesser environmental impacts.

The regulations shall be administered in a fair, reasonable, and consistent manner and not as a means of inhibiting or interfering with legitimate, well-planned mineral operations.

These regulations apply to all unpatented millsites, tunnel sites, and mining claims, including those not subject to 30 U.S.C. 612, and to activities, primarily prospecting, which may be conducted under the mining laws but not on claims.

The provisions of the regulations for operating plans will not be used as means of solving existing trespass and unauthorized occupancy problems (FSM 2818).

The statutory right of the public to prospect, develop, and mine valuable minerals and to obtain a patent, will be fully honored and protected. Confidential information relating to those rights and obtained through the administration of these regulations will be protected to the full extent authorized by law.

Relationships between State and Federal Agencies

The primary objective of this cooperative impact statement is to fulfill both State and Federal agencies' requirements mandated under NEPA and MEPA. The relation ship between State and Federal agencies, therefore, has been one of voluntary co-operation, rather than one dictated by statute or other mandate.

I. DESCRIPTION OF WESTERN VERMICULITE'S MINING PROPOSAL

A. Proposal of Western Vermiculite Company

1. Background

a. Purpose

Western Vermiculite Company proposes to develop and mine approximately 50,000 tons of vermiculite ore per month from an area in the Bitterroot National Forest near Hamilton, Montana known as ABM Ridge. The life expectancy of the proposed mining program is approximately 7 years. The resulting waste, called tailing, would be produced at a rate of 37,000 to 38,000 tons per month.

Mine development and construction of associated facilities cannot begin pending issuance of a final joint State-Federal Environmental Impact Statement and securance by Western Vermiculite of all necessary Federal, State and local approvals.

The project area lies in the St. Clair Creek drainage of the Sapphire Mountains, Ravalli County, Montana (Figure 1). Ore would be milled at a plant site near the mine and the resulting vermiculite mineral transported by truck to a railroad facility where it would be loaded into rail cars and transported to an exfoliation plant for expansion. Western Vermiculite is also investigating the possibilities of constructing a small exfoliation plant for the purpose of supplying the local market with exfoliated vermiculite which is utilized as insulation and as a soil amendment.

b. History

The earliest known vermiculite location in the project area occurred in 1930 by Swift Chamberlain and Bert Garnett. In the next three years, several shallow pits and short adits were excavated to prospect.

Chamberlain and Garnett then leased the mining claims to a firm based in Minneapolis, Minnesota during the years of 1934-1936. This firm constructed a road to the prospect sites, however, no extensive exploration was conducted.

In 1947, Robert Chamberlain and Cliff Jacobson leased the mine from Swift

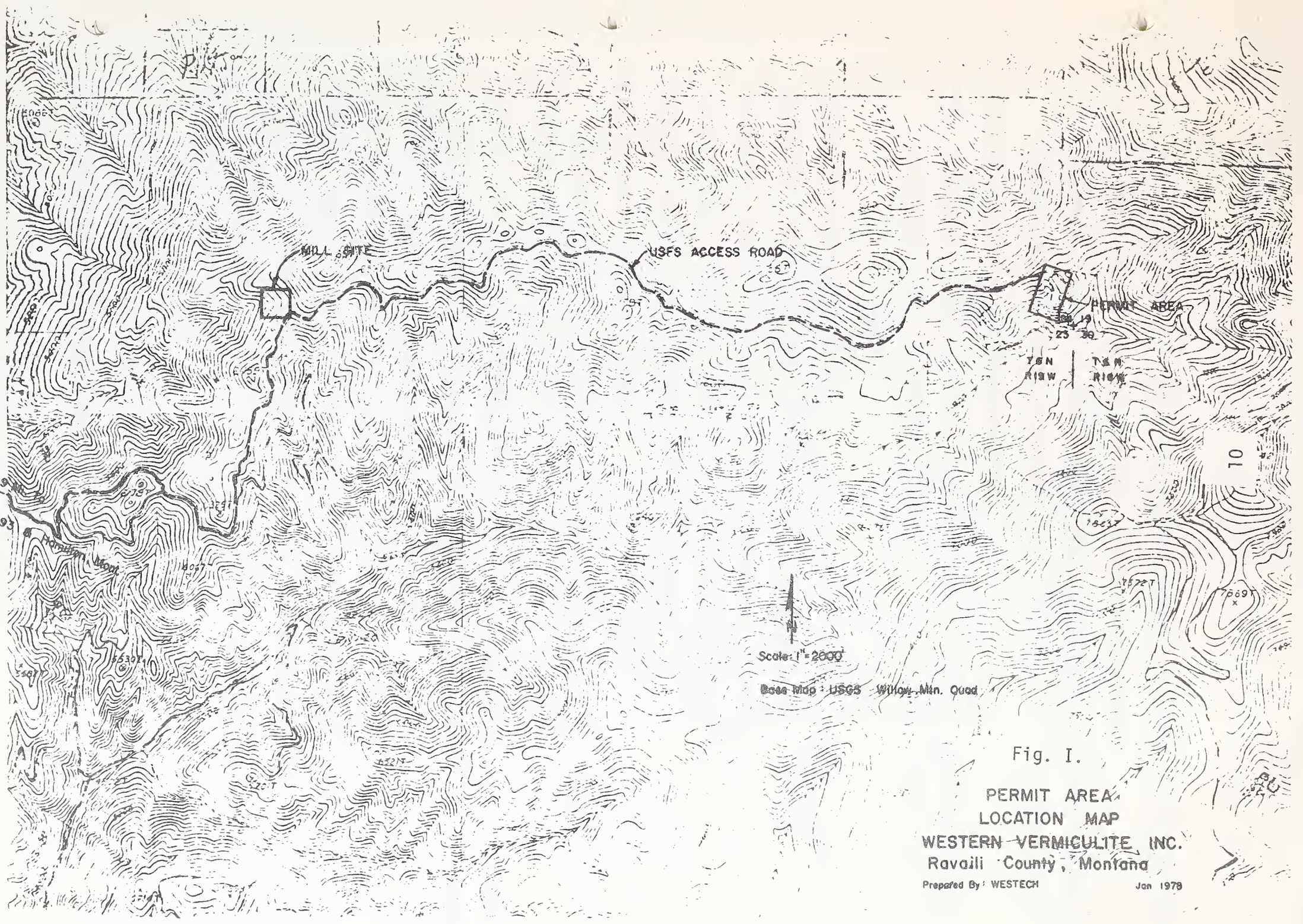


Fig. I.

PERMIT AREA
LOCATION MAP
WESTERN VERMICULITE INC.
Ravalli County, Montana

Prepared By: WESTECH Jan 1979

Chamberlain and Bert Garnett and they in turn formed a company; Gird Creek Vermiculite Porducts Co., Incorporated. The existing road was repaired and upgraded to begin the mining operation. An exfoliation unit was constructed on the Chamberlain property in Hamilton and the first exfoliated vermiculite was sold to the Eagles Aerie to insulate the new hall addition on their existing building. Numerous homes in Hamilton and Missoula were also insulated with exfoliated vermiculite supplied by this company. The excess vermiculite was shipped, by truck, to markets in the eastern sections of the state.

The mine was inactive from 1950 until 1955 at which time Verilite Mines, Incorporated was formed. The road was again upgraded and the property improved.

On August 2, 1976 a lease was obtained by National Vermiculite from Robert Chamberlain. National Vermiculite formed a partnership with Argee Corporation of Iowa. Together these corporations are known as Western Vermiculite Company.

2. Road Development

Western Vermiculite proposes to reconstruct approximately three and one-half miles of Forest Service road No. 716 between the mine and the mill site Three miles of the reconstruction would be on National Forest and one-half mile on private land. The road would be reconstructed to a 24 foot width conforming to Forest Service specifications.

Approximately one-half mile of new road construction would be necessary to provide an access and haul route from the mine to the existing road system. The maximum gradient of the road would be 5 percent. Cut and fill slopes would be seeded as soon after construction as possible while the soil is still loose and not crusted. Eighteen inch corrugated metal pipe would be installed as necessary to provide for surface drainage.

3. Mining Sequence

Preliminary exploration work has revealed that the vermiculite ore would

require no blasting prior to excavation and loading. It is anticipated that dozer-rippers and frontend loaders would be the major heavy equipment utilized for the mining operation, specifically, a Cat 988 front-end loader and a Cat D8H dozer-ripper.

Mining on the ABM Ridge site would commence at the 6,900 foot level and proceed northward for approximately 500 feet.

The dozer-ripper would traverse the ridge, following the contour, utilizing the ripper to loosen the vermiculite ore. The front-end loader would then proceed to gather the ore and load it onto 30 ton K-W Brute haul trucks for transport to the mill site.

There would be a series of these traversing cuts from the 6,900 foot level to the 7,000 foot level of ABM Ridge that would be approximately 30 feet wide and would remove an average thickness of 30 feet of the vermiculite ore.

This method of mining would result in a temporarily terraced or benched topography on the ridge. As mining continues, these benches will be "pushed back" and the ridge will eventually be leveled to the 6,900 foot contour with a resulting highwall at the north end with a slope of 2.5:1, varying in height from 40 feet to 70 feet. This high- wall will be benched and utilized as an equipment storage area and haul road. Approximately nine acres will be mined in this manner. Figure 1-1 is a post mining contour map of ABM Ridge with a cross-section reference line to be used with the pre and post-mining cross-section map (Figure 1-2).

It is estimated that mining would be conducted eight months out of each year. This would result in an ore stockpile which would keep the milling process operating 11 months out of the year.

4. Milling Sequence

The vermiculite ore from the mining operation would be stockpiled on the Ore Stockpile (Figure 1-3).

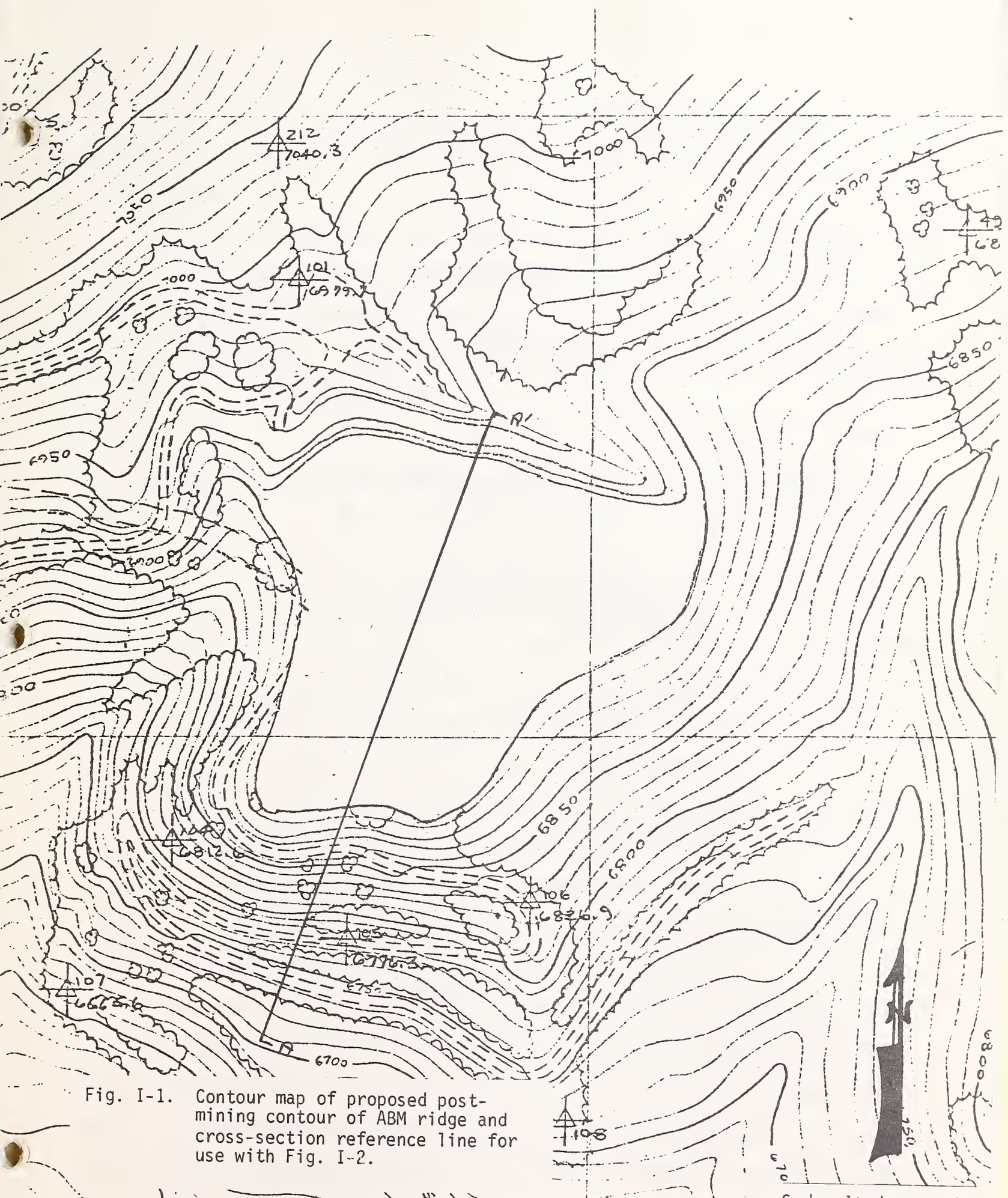


Fig. I-1. Contour map of proposed post-mining contour of ABM ridge and cross-section reference line for use with Fig. I-2.

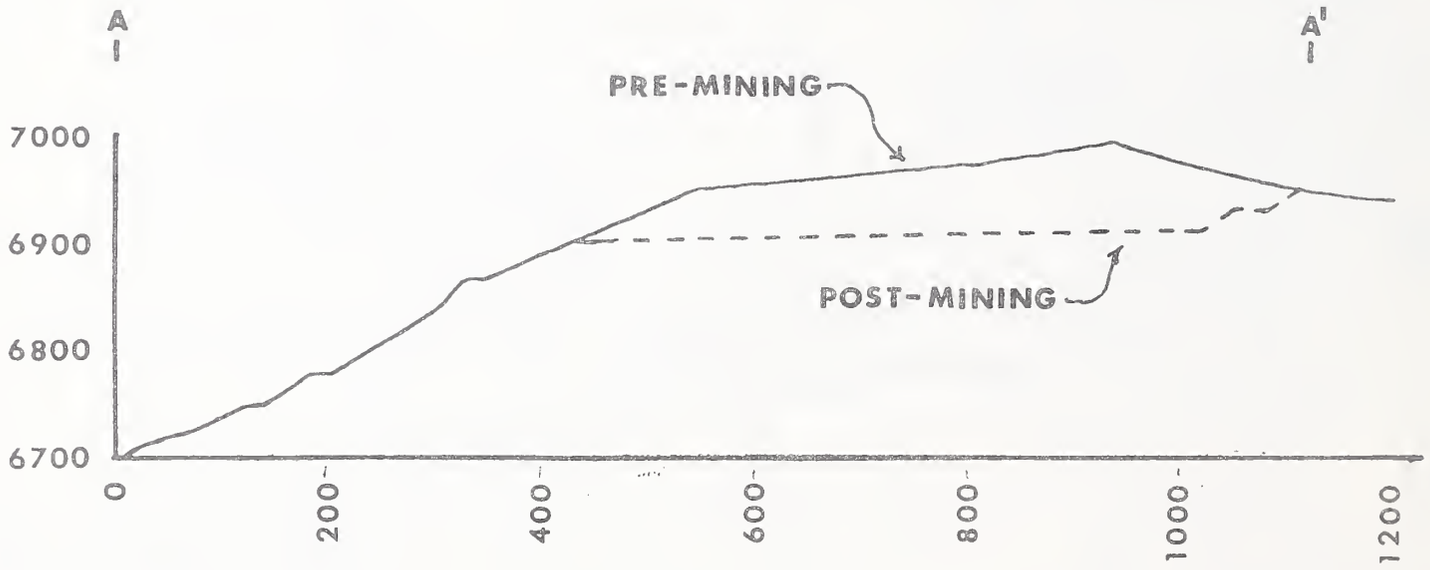


Fig. I-2. Pre-mining and proposed post-mining cross-section map of ABM Ridge (in feet).

The first phase of the beneficiation process would be to pre-screen the ore to remove the finer grades of crude vermiculite to avoid duplication of screening in later processes.

A Cat 966 front-end loader would be used to charge the mill. The ore would then be crushed and screened to separate mill waste and the different size grades of crude vermiculite. Mill waste (tailings) would be produced at approximately 37,000 to 38,000 tons per months. Five sizes or grades of crude vermiculite would be produced:

Grade	Size
#1	Minus 3/4" to plus #8 mesh
#2	Minus 5/16" to plus #8 mesh
#3	Minus 1/4" to plus #16 mesh
#4	Minus #4 mesh to plus #30 mesh
#5	Minus #16 mesh to plus #50 mesh

The crude vermiculite would then be transported, by conveyor, to a dryer where excess moisture is removed. The crude vermiculite is then conveyed to a bag house where dust and other particulate matter would be removed. A magnetic separater would be used to separate ferrous particulates from the crude vermiculite.

The front-end loader would then be utilized to load the milled crude vermiculite into highway type transport trucks for transport to the Victor rail siding.

If it became apparent that erosion of stockpiled ore or mill waste could not be avoided, possibly resulting in degredation of water quality, Western Vermiculite would install a settling pond at the location shown on Figure 1-3.

The crude vermiculite would be hauled from the mill site to the Victor rail siding for off-loading. Facilities at the rail siding would consist of a hopper-conveyor to load the rail cars and a small furnace to exfoliate test samples of the product. The amount of each grade to be shipped would be determined by the quality of ore, milling efficiency, shipping costs and market demands. Total monthly prod-

uction would be approximately 12,000 tons.

Western Vermiculite would investigate the possibility of constructing a small exfoliation plant for the purpose of supplying the local market.

5. Fuel and Power

Power for the crushing operation would be supplied by diesel generators. At the present time a 250 KW generator is being utilized, but may be increased to a 423 KW when under full production. A hook-up to existing power lines is not proposed due to economic constraints.

Fuel for the heavy equipment and the generators would be stored in above ground commercial fuel dispensing tanks at the mine and mill sites and on the back of a pick-up truck equiped with fuel dispensing tanks.

6. Employment Requirements

Total manpower requirements of Western Vermiculite Company for mining, milling and office staff would be approximately 50.

Approximately 42 skilled and unskilled laborers will be employed in the mining and milling processes. Western Vermiculite Company would have a training program for training local unskilled workmen for positions at the mine and mill.

Professional positions of the operation would be: General Manager, General Superintendent, Mill Superintendent, Mine Superintendent, Mine Engineer, Engineer Technician, Office Manager and a Secretary.

It is anticipated the mine would be worked one 8 hour shift per day, and the mill would be in use three 8 hour shifts per day. However, more than one shift may be needed at the mine to operate at mill capacity.

7. Reclamation Plan

a. Mine Site

Prior to the mining of the ABM Ridge site, Western Vermiculite would strip and stockpile all available topsoil. On areas which have no topsoil, the top 12 inches

of material would be stripped and stockpiled for use as soil material at the time of reclamation. The soil stockpile would be located as shown on Figure 1-4 and vegetated with the seed mixture listed below in order to prevent erosion.

Species	lbs./Acre, Pure Live Seed
Pubescent wheatgrass (Luna)	5
Streambank wheatgrass (Sodar)	6
Hard fescue (Durar)	3
Dwarf yellow sweetclover	1

(Indian ricegrass may be used as an alternate)

As described in the mining plan, upon completion of mining, the topography of the mine site would consist of a level bench at the 6,900 foot elevation, sloped at a minimum of one percent to the east to control surface runoff, and a highwall at the north end of the mine site sloped to a 2.5:1 grade. The walls of the site would be smoothed and benched as necessary to provide a stable configuration. If conditions warrant, water diversion structures would be installed to prevent erosion.

When grading has been completed, approximately 12 inches of the previously stockpiled topsoil would be utilized to veneer disturbed areas at the mine.

A vegetation cover commensurate with the reclaimed use of the land (wildlife habitat) would be established by the company. The Bitterroot National Forest has published revegetation recommendations for disturbed areas on the Forest. For south aspects and ridge tops, the Forest Service recommends the following mixture, which will be used by the company:

Species	lbs./Acre, Pure Live Seed
Hard Fescue (Durar)	4
Intermediate wheatgrass (Tegmar)	5
Canada bluegrass	1
Dwarf yellow sweetclover	1

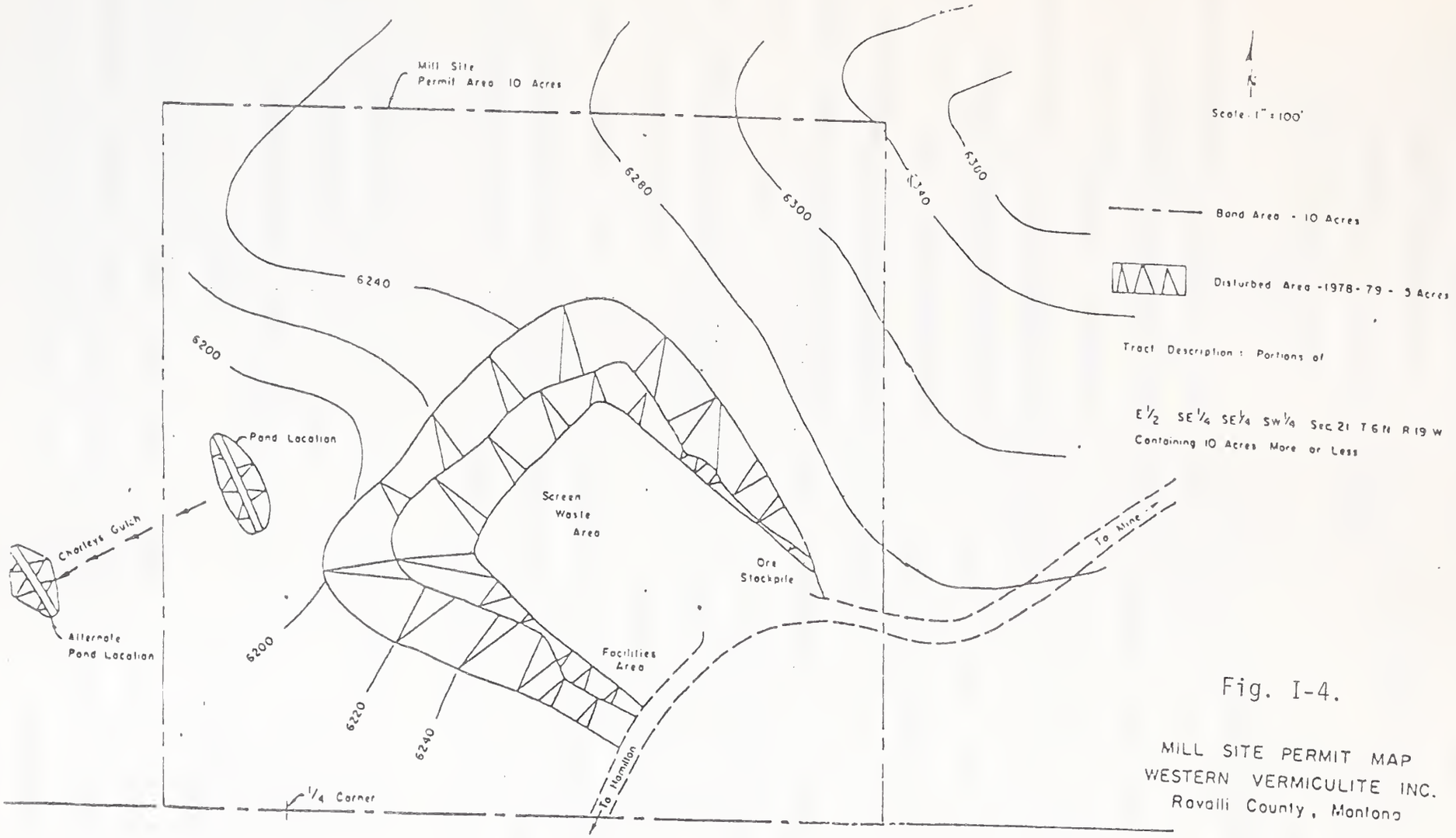


Fig. I-4.

MILL SITE PERMIT MAP
WESTERN VERMICULITE INC.
Ravalli County, Montana

Timothy	2
Orchardgrass	4
Bromegrass	4

Seeding rates would be doubled on areas which cannot be drill seeded. Mulch, Hydromulching or other protective covering would be placed on the soil surface. Two-hundred (200) pounds of 16-16-16 fertilizer would be applied per acre at the time of seeding and again following seed establishment.

In addition to these grasses the following forbs and shrubs will be used for revegetation:

Woods rose, chokecherry and beargrass (on the drier sites)

Chokecherry, elderberry, shrubby cinquefoil, serviceberry (all other sites)

Shrubs will be spaced 3 feet apart (approximately 4,800/acre). Terraces on the reclamation sites will help to provide a better microclimate for shrub plantings.

If the initial revegetation attempt were unsuccessful, the company would seek the advice of the Department and the Bitterroot National Forest and incorporate new methods necessary to reestablish vegetation.

The time of seeding would have to reflect elevation and snowpack conditions. The moisture and temperature patterns would reflect optimum seeding times, at higher elevations this may not be possible until the end of June.

Reclamation would be as concurrent with mining operations as feasible and would be completed not more than two years after completion or abandonment of mining on any portion of the mining complex. Revegetation would be attempted in the first appropriate agricultural season after completion of necessary grading.

b. Mill Site

Following removal of the mill facility, the slopes of the mill waste dump and tailings dump would be graded to a gradient where they would not be susceptible to erosion and slumping when wet. If necessary to control erosion, the slopes would

also be benched and would be protected by the installation of water diversion structures.

When grading has been completed, approximately 12 inches of previously stockpiled topsoil would be used to veneer disturbed areas at the mill site. Revegetation of the area would be identical to the methods utilized at the mine site. Vegetation species mixture would be the same as that utilized in the stabilization of the topsoil stockpile.

c. New Road Construction

Unless the Forest Service desires it remain intact for forest access, the one-half mile of new road construction would be reclaimed upon completion of the mining operation. Grading of the road would consist of returning fill material previously stockpiled, to the road cut, thereby restoring the land to the predevelopment contour. Culverts would be removed and the natural drainage patterns would be restored.

Vegetation species and revegetation methods employed at the mill site would be used to re-establish vegetation cover.

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. The Physical Environment

1. Location and Description of the Area

The proposed mine is located in the SE¼ of Section 24, Township 6 North, Range 19 West in Ravalli County. The mill site proposed for this operation is located in portions of Section 21, Township 6 North, Range 19 West in Ravalli County. The actual mine site is located on an area known as ABM Ridge approximately one mile west of Skalkaho Mountain, in the Sapphire Range in southwestern Montana and approximately 9 miles east of Hamilton, Montana (see cover).

2. Topography

ABM Ridge has an elevation of 6986 feet and is characterized by steep slopes (45-80 percent) with a dense coniferous tree cover with the exception of the vermiculite outcrop. The slope is broken with narrow benches and a drainage pattern of small steep-gradient streams with deep V-shaped channels. This area is drained by St. Clair Creek. The upper reaches of this stream are characterized by steep gradients with narrow deep V-shaped channels. The lower reaches of St. Clair Creek to its confluence with Gird Creek has a gentle gradient with a shallow U-shaped channel. The land adjacent to the lower reaches of this stream is gentle rolling.

3. Climate

The climate of the Bitterroot Valley is characterized by relatively mild winters, cool summers, light precipitation, and very little wind. Large daily and seasonal fluctuations in temperature are common.

The following data charaterize the Hamilton, Montana area:

Mean minimum temperature . . . . . 33.2 F

Mean maximum temperature . . . . . 59.2 F

Highest recorded temperature . . . . . .103.0 F

Lowest recorded temperature . . . . . .-39.0 F

Length of growing season . . . . . .130 days

Average date last killing frost. . . . . .May 16

Average date first killing frost . . . . . .September 23

Average annual precipitation . . . . . .12-16 inches

Precipitation is considerably greater in the Bitterroot Mountains than in the Sapphire Mountains and in the valley. The pattern of precipitation shows two maximums; one in May and June is characteristic of the Great Plains, another in the fall is characteristic of the Pacific Northwest.

Forest Service personnel have estimated that the mine area receives 38 inches of precipitation annually, in a range of 35 to 45 inches. This amount of moisture is transformed into approximately 14 inches of runoff in a typical year (USFS, 12-14).

Wind direction generally is from the southwest and of greater velocities in the higher elevations. Less evaporation occurs at higher elevation during the year, but may occur at a greater rate during the summer months due to the effects of wind and increased solar radiation.

4. Air Quality

The Bitterroot Valley has a north-south orientation with the Bitterroot and Sapphire Mountains rising more than 4,000 feet above the valley floor on each side. Since the predominate synoptic wind flow is a westerly, these mountains tend to block the flow in the valley preventing the normal fulushing action of the wind. Frequent low-level inversions also tend to trap air pollutants in the area. The inversions act as a lid on a box created by the valley walls. Any air pollutants emitted are trapped in the valley until the inversion is removed by solar heating or strong winds. Upslope and downslope winds caused by differential heating on the valley walls keep the air mixed below the inversion but again the air pollutants cannot escape until the inversion is broken. Normal nighttime downslope winds tend to accumulate in the valley bottoms any pollutants emitted during the night. The potential

for air pollution problems caused by meteorological conditions is greater during the fall and winter season. During these seasons, the decrease in solar heating hours and the reflection of solar insolation by snow cover prevent the inversions from being removed. Frequent high pressure systems during the fall-winter season cause inversions in this area to persist for several days at a time, during which time any air pollutants emitted will continue to accumulate in the valley. During the spring and summer season, increased wind speeds and increased convective activity reduce the chance of air pollutants to be trapped in the valley.

5. Geology

a. Geologic History

Less than 100 million years ago, during the upheaval and formation of the Rocky Mountains, numerous granitic intrusions were forced into the earth's surface. The largest intrusion in the Northern Rocky Mountains was the Idaho Batholith, which now is extensively exposed over much of north central Idaho and the extreme southwestern portions of Montana. This large molten mass of rock was ingested into the existing country rock, heating and altering the peripheral rocks. In addition the intrusion uplifted and caused a large block of earth (sapphire block) to become detached and slide to the east.

Within the last 1 million years the Northern Rockies, or for that matter the Northern Hemisphere, underwent a dramatic series of climatic changes. The climate periodically became colder and wetter,and then drier and warmer. The colder episode culminated in large continental glacial ice sheets, some of which advanced southward into Northern Montana. Alpine glaciers appeared in Montana's mountain ranges (Sapphire Mountains included) south of the continental ice sheets during these advances. The glaciers and the increased precipitation scrapped and eroded the existing land forms extensively. The vast amount of precipitation filled many here-to-for inclosed valleys (Bitterroot and Missoula Valleys) with sediment and created river systems to

carry the run off to the oceans. Our present drainage system is the product of these glacial advances in combination with the underlying geologic features.

b. Geologic Setting

The Sapphire Mountains are a complex assemblage of folded and faulted precambrian sedimentary rocks (older than 600 million years old). These geologic units have been further complicated by several small granitic magma intrusions. This area's structural complexity is a product of the Northern Rocky Mountain building processes; specifically the intrusion of the Idaho Batholith and granitic stringers, and the subsequent sliding off of the Sapphire Mountains.

The geology of the Western Vermiculite mine site is very indicative of the geology described above. The mine site lies at the extreme eastern margin of the Idaho Batholith; several large outlying granitic intrusions (quartz monzonite) are located within the Sapphire Mountains. Vermiculite-Hydrobiotite ore occurs in a pyroxenite (dark-colored igneous rock) intrusion (Figure 1-4A). The pyroxenite body and associated dikes were implaced into impure argillites and limestones of the Precambrian Newland formation.

c. Ore Body

The Western Vermiculite pyroxenite deposit is possibly lens or pod shaped and contains these associated minerals; hornblende, metadiorite, magnetite, sphene, apatite and minor amount of tourmaline and titaniferous garnet. The vermiculite-hydrobiotite mineral that is the subject of mining, occurs in scattered and concentrated forms within the pyroxenite body. Concentrations of vermiculite also occur in dike-like or tabular bodies (six inches to two or three feet wide) in which crystals one to four inches in diameter are present (Perry, 1948).

Vermiculite is a hydrated magnesium-aluminum-iron sheet silicate of variable

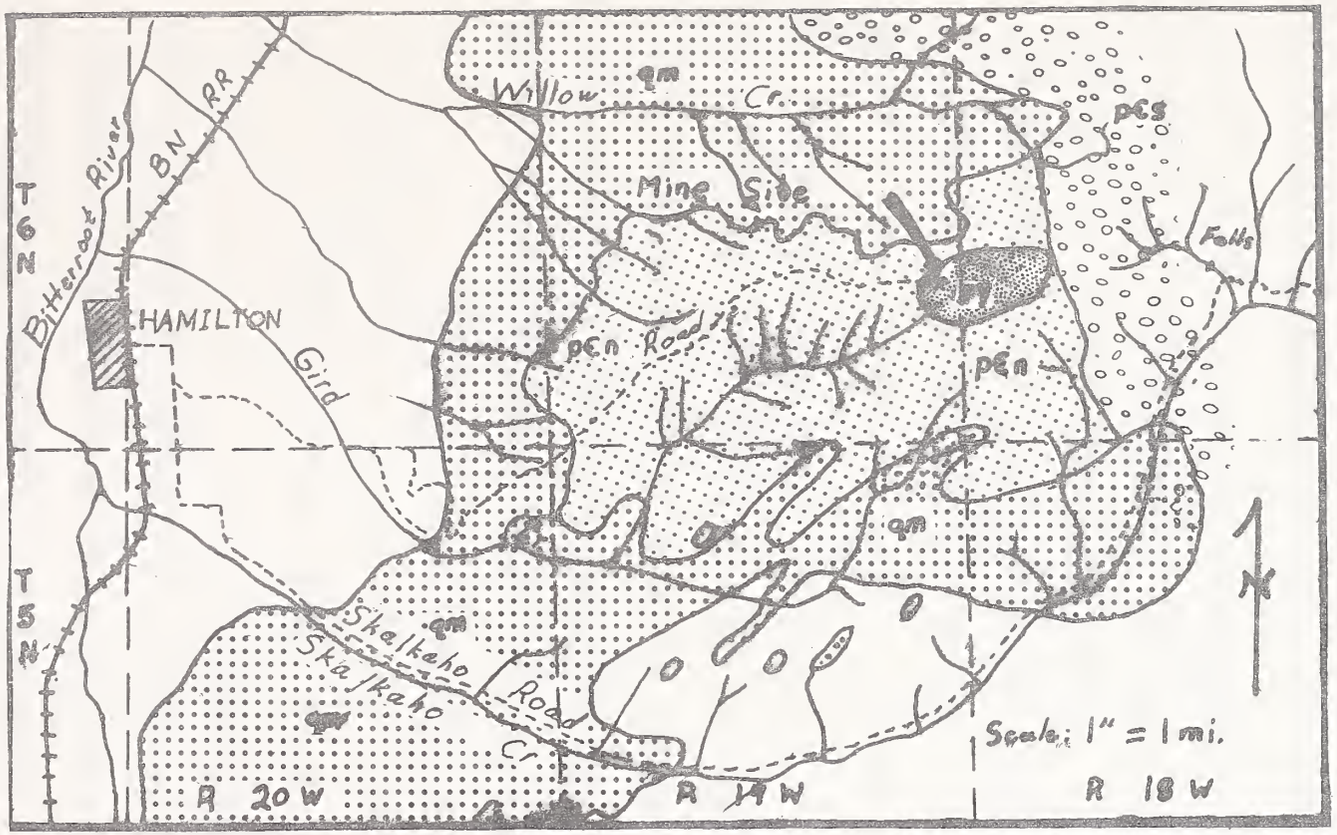


Figure 1-4A.--Map showing location of vermiculite deposits near Hamilton. pCs, Spokane formation; pCn, Newland formation; qm, quartz monzonite; py, vermiculite-bearing pyroxenite.

composition. The crystal structure is similar to that of mica and biotite. In biotite, potassium ions occupy regular sites which overlap corresponding sites in adjacent layers. The electronic charges of these ions help to hold the layers together. In vermiculite, only some of the sites are occupied, and these only by magnesium, but a double layer of water molecules also is present in these interlayer regions.

Expanded vermiculite is completely incombustible and retains its thermal insulating value to 2000°F. For the higher temperatures, such as for use in fire walls, in the shipment of hot steel ingots, or in refractories, use of a finer grade has the advantage of better thermal reflection of radiated heat.

Crude vermiculite denotes the mined ore that has been beneficiated and sized. The exfoliated product is also called vermiculite. The chemical composition of crude vermiculite and expanded vermiculite ranges from 4 to 14 percent. The property of exfoliation, which causes bulk to increase from 8 to 12 times and yields a product with a density of 4 to 11 pounds per cubic foot, is dependent upon conversion of part of the water of hydration to steam which forces the laminae apart at right angles to the cleavage planes to form an accordion-like product.

Chemical composition is of little value in determing expandability of vermiculite, and exfoliation tests provide the only satisfactory evaluation.

d. Other Minerals

Scattered through the general area around the Western Vermiculite mine are small occurrences of gold, silver, lead, copper, molybdenum, and sapphires, all considered to be in insignificant quantities and concentrations to warrant development.

e. Oil and Gas

The oil and gas potential of the area surrounding the Western Vermiculite Mine is not well known. The potential of an oil and gas discovery may be considered small because the geology is not very favorable.

f. Geothermal

The area in question does have some potential for geothermal resources. Due to igneous activity in the recent past plutons were implaced into the area as late as 72-76 million years ago (Hyndman and others, 1972). Sleeping Child Hot Springs is located about 12 miles southwest of the mine and may be an indicator of possible future geothermal power production potential. The temperature of Sleeping Child Hot Springs at the surface is about 50°C (Leonard and others, 1978). Given the present state of the art in geothermal power generation, water temperatures of less than 90°C are not looked on as economically feasible.

6. Soils

a. The Soil Resource

Soils in the ABM Ridge-St. Clair Creek drainage vary from shallow to deep, are well drained and derived mostly from weathering of grantic or gneiss rock. Soils on the rounded ridges and upper side slopes are moderately deep to deep with loamy surfaces and sandy subsoils. Soils on very steep sideslopes are mostly shallow with sandy surfaces and subsoils. Rock outcroppings are common on the very steep portions of the slopes.

The soils are low in productivity. Their moisture holding capacity is moderate to low. Plant moisture stress is high, especially on the shallow soils on steep, southerly exposures. Their cover is primarily coniferous trees and related shrubs and grass species. Douglas-fir and ponderosa pine occupy the warm, dryer slopes and lodgepole pine is most common on the cool sites.

b. Soil Types

Forest service personnel have completed preliminary landtype mapping in the area proposed for this mining operation (see figure I-5). The Forest Service land capability rating system is a compendium of soil and geologic features, erosion hazard

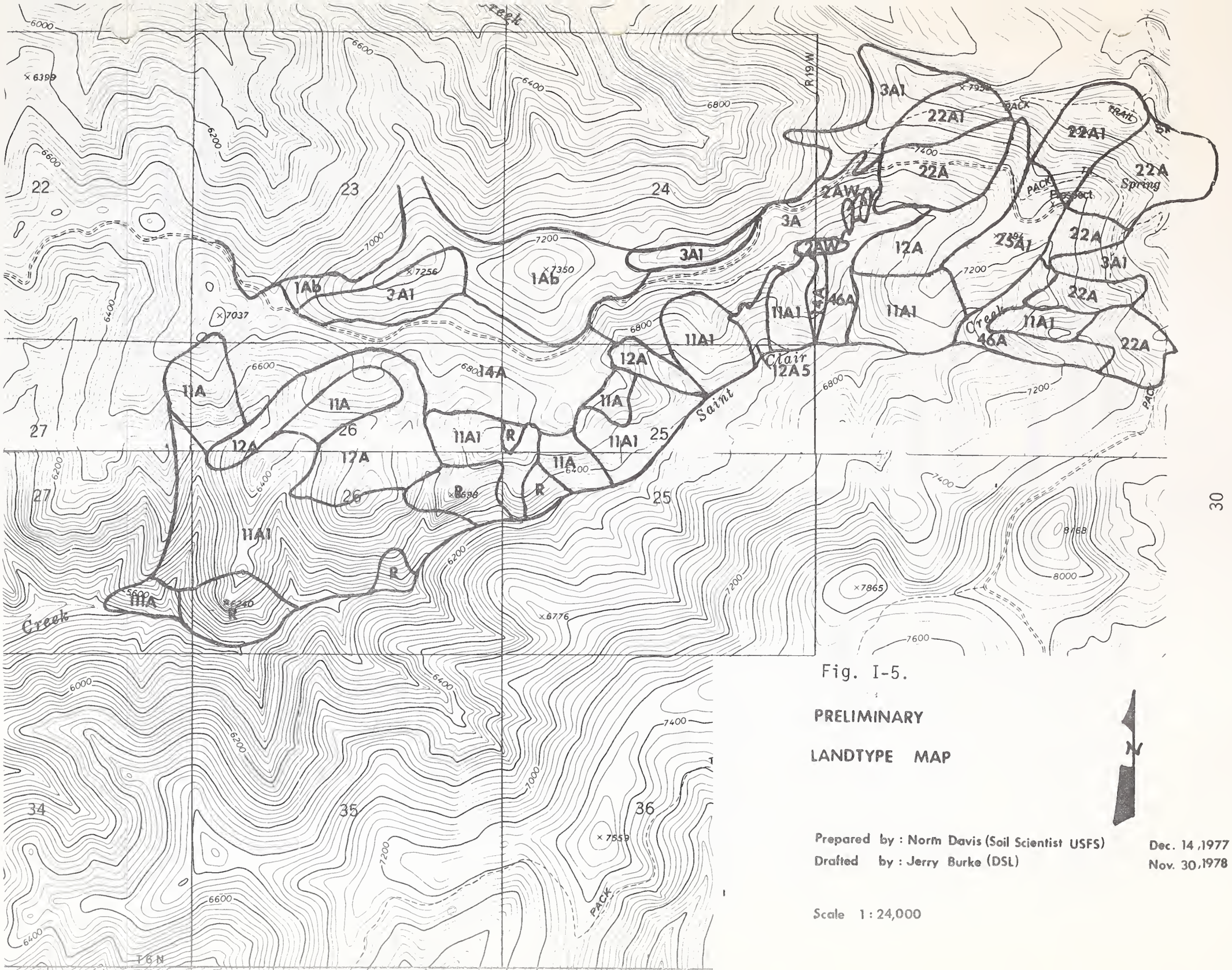


Fig. I-5.

PRELIMINARY

LANDTYPE MAP

Prepared by : Norm Davis (Soil Scientist USFS) Dec. 14 ,1977
Drafted by : Jerry Burke (DSL) Nov. 30,1978

Scale 1 : 24,000

potential, elevation, slopes, climatic features, hydrology and vegetation. The following information contains the Forest Service explanation for the landtype symbols used on the preliminary landtype map (Figure I-5):

Landtype Symbol

Landtype Unit 3

Textural Group A

Landtype Phase 1

Textural Groups (Subsoil Textures)

A Sandy

B Loamy

C Clayey

Landtype Phase

1. very rocky; 10-25 percent of area consists of rock outcroppings
2. extremely rocky; 25-50 percent of area consists of rock outcroppings

The proposed mine site is described as landtype 11A1. The Forest Service evaluation of types 11A and 11A1 is as follows (description for types 11A and 11A1):

Landtype 11A1 occurs in a range of elevation from 4000 to 7000 feet on south and west exposures. Slopes are steep, ranging from 50 to 70 percent.

Soils are shallow to moderately deep and well drained. They have a thin (2-6 inch) brown sandy loam surface and brownish yellow gravely sandy loam to loamy sand subsoil. They are underlain with highly weathered granite gneiss or schist at depth from 18 to 40 inches. Rick outcroppings occupies 10 to 25% of the area.

Fertility of these soils is low. Moisture holding capacity is low, therefore plants tend to stress during dry periods. Their permiability is moderate to high.

Land type 11A is very similiar to 11A1 in all characteristics except there is no rock out croppings.

Other landtype descriptions identified on the preliminary Forest Service map are

described in appendix A.

7. Water Resources

a. Groundwater Resources

The Montana Bureau of Mines and Geology has conducted a study of 100 wells in the Bitterroot Valley. Maps in this report indicate the groundwater moves generally towards the Bitterroot River. On the east side of the river, the movement is almost parallel to the area between Hamilton and Stevensville; northwestward toward the river along Skalkaho Creek and Burnt Fork Creek.

The bedrock of the Sapphire range was identified as mostly Precambrian argillite, quartzite, and limestone. It was found to contain very little or no groundwater.

An unpublished report from the Montana Department of Health and Environmental Sciences, Water Quality Bureau, further identifies the groundwater resources:

> *Precambrian sedimentary rocks are present in the southern tip of the county and in the Sapphire Mountains. These rocks consist of quartzite, argillite, slate, limestone, and dolomite of the Belt Series. These rocks are generally poor aquifers (water-yielding materials) and are little used as a source of groundwater. Igneous rocks underlie large areas in the western and southeastern parts of the county. The igneous rocks are primarily of a granitic composition but include extrusive and shallow intrusive volcanic rocks. Except for fractures and fault zones, these rocks contain little groundwater.*

b. Surface Water

(1) Sample Site

Water quality sampling was performed to determine existing conditions for surface waters, particularly for those parameters most likely to be impacted by the proposed mining activities.

Water quality data available at the beginning of the investigation provided a good baseline for some streams, but was limited in locations relative to possible impacts. As a part of the baseline assessment investigation, the U.S. Forest Service sampled one site on St. Clair and the Montana Department

of Health and Environmental Sciences, Water Quality Bureau, sampled one site on St. Clair Creek.

These samples were analyzed for physical properties, major ions, metals and nutrients. Water quality parameters examined were:

1. specific conductivity (an overall measure of total dissolved solids),
2. nutrients - phosphate and nitrate in various forms as an indicator of trophic status of the water,
3. temperature,
4. metals - zinc, iron and copper and,
5. turbidity - measures suspended particulate matter.

(2) St. Clair Creek

Results of the water sample analysis of the water sample collected October 14, 1977, are presented in Table I-1 and the results of the Water Quality Bureau's sample collected July 18, 1978, are presented in Table I-2. An additional sample of suspended sediment was collected by Forest Service during spring snowmelt 5/5/78, giving 4.8 mg. at 3.15 cfs.

Certain conclusions may be drawn regarding St. Clair Creek water quality in the vicinity of the mine at or near base flow. The water is a slightly hard, circumneutral, calcium-bicarbinate type. Suspended solids are negligible. Plant nutrients (nitrogen and phosphorus) are well below critical levels for creating nuisance plant conditions. Heavy metals are at or below detection limits. In short, the water is pristine.

The water from St. Clair Creek is used for irrigation. Increased sediment could be detrimental to irrigation equipment.

(3) Stream Reach Inventory and Channel Stability Evaluation St. Clair Creek

During the summer of 1977 stream reach and stability surveys were conducted in

the upper reaches of St. Clair Creek. These surveys cover the portion of St. Clair that would realize the most immediate impact.

The stream channel stability rates as fair in all of the reaches surveyed. This rating was derived from the R1 Stream Reach Inventory and Channel Stability Evaluation Procedure developed by the U.S. Forest Service.

The streams fair rating is based on the frequent occurance of (1) root mat overhangs, (2) debris jams, (3) slumps, (4) and the relatively high percentage of fine gravel, sand, silt, clay and muck.

There is also the presence of darker micaceous fine sandy sediments in the stream. This component however was not used in the evaluation process.

TABLE I-1

STATE	MONTANA	COUNTY	RAVALLI
LATITUDE-LONGITUDE		SAMPLE LOCATION	6N 18W 19BDC
TOPOGRAPHIC MAP	WILLOW CREEK DAM	SAMPLE SOURCE	STREAM
GEOLOGICAL SOURCE		STATION CODE	
DRAINAGE BASIN	76*H	BOTTLE NO.	B10218
AGENCY + SAMPLER	USFS * LKH	ALTITUDE OF SAMPLE POINT	6420. FT 50
DATE SAMPLED	10-14-77	TOTAL DEPTH OF WATER	
TIME SAMPLED	1300	STAGE HEIGHT	
LAB + ANALYST	MBMG * GAM	DEPTH TO SAMPLING POINT	
DATE ANALYZED	11-22-77	FLOW MEAS METHOD	
SAMPLE HANDLING	4230	WATER FLOW RATE	
METHOD SAMPLED	GRAB	WATER USE	MULTIPLE USE

SAMPLING SITE ST CLAIR CR BASE FLOW
DRAINAGE BASIN BITTERROOT RIVER

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	16.6	0.828	BICARBONATE (HCO3)	64.9	1.064
MAGNESIUM (MG)	3.4	0.280	CARBONATE (CO3)	.0	0.000
SODIUM (NA)	1.0	0.043	CHLORIDE (CL)	.25	0.007
POTASSIUM (K)	2.3	0.059	SULFATE (SO4)	7.2	0.150
IRON (FE)	.03	0.002	NITRATE(AS N)	.023	0.002
MANGANESE (MN)	.01	0.000	NO3+NO2 TOT(AS N)		
ALUMINUM (AL)			FLUORIDE (F)	.1	0.000
SILICA (SIO2)	19.7		O-PHOSPHATE(AS P)		
TOTAL CATIONS		1.212	TOTAL ANIONS		1.222

STANDARD DEVIATION OF ANION - CATION BALANCE 0.09 SIGMA

LABORATORY PH	7.86	TOTAL HARDNESS AS CACO3	55.
FIELD TEMPERATURE	38. F	TOTAL ALKALINITY AS CACO3	53.
CALCULATED DISSOLVED SOLIDS	82.6	SODIUM ADSORPTION RATIO	0.1
SUM OF DISS. CONSTITUENTS	115.5	RYZNAR STABILITY INDEX	9.1
LAB SPEC.COND.(MICROMHOS/CM)	120.0	LANGLIER SATURATION INDEX	-0.6

ADDITIONAL PARAMETERS

CO2,FIELD (MG/L AS CO2)	10.	HARDNESS,FILED(MG/L AS CACO3)	4.
CNDUCTVY, FIELD MICROMHOS	115.	ALKALINITY,FLD(AS CACO3)	68.40
PH,FIELD(SU)	7.5	CADMIUM,DISS(MG/L AS CD)	.01
COPPER,DISS (MG/L AS CU)	.01	MOLYBDENUM,DISS(MG/L-MC)	.02
NICKEL,DISS (MG/L AS NI)	.01	LEAD,DISS (MG/L AS PB)	.05
SILVER,DISS (MG/L AS AG)	.01	ZINC,DISS (MG/L AS ZN)	.01
ARSENIC,DISS(UG/L AS AS)	2.0		

REMARKS: USFS DARBY RD BITTERROOT NF BASE FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED: TOT=TOTAL SUSP=SUSPENDED
TR=TOTAL RECOVERABLE (M)=MEASURED (R)=REPORTED (E)=ESTIMATED M=METERS

PROCESSING PGN: GWANAL(FORM 153)
FUND:

PERCENTAGE REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
68	23	3	4	0	12	87	0	0

Table I-2 Results from a partial analysis of a St. Clair Creek water sample taken at a location above the Western Vermiculite Mine (T6N R18W Sec. 19) on July 18, 1978.

Parameter	Value (mg/l)
Total Suspended Solids (SS)	10
Nitrate (NO3 as N)	0.01
Ammonia (NH3 as N)	0.01
Ortho-phosphate (PO4 as P)	0.025
Total Phosphorus (P)	0.028
Cadmium	0.001
Copper	0.005
Lead	0.005
Zinc	0.005

B. The Biological Environment

1. Flora

a. Habitat Types

The mine site is between 6893 feet and 6969 feet in elevation. Linear distance between the start of the access road and the mine site is approximately 6.5 miles. The dramatic elevation change in this distance has contributed to the creation of several habitat types (Figure II-1), mapped by the Montana Department of Natural Resources and Conservation (1976).

Habitat types (Pfister 1974) are:

(3) Agricultural (irrigated cropland, dry cropland, bottomland mix)

(4) Bunchgrass (grassland)

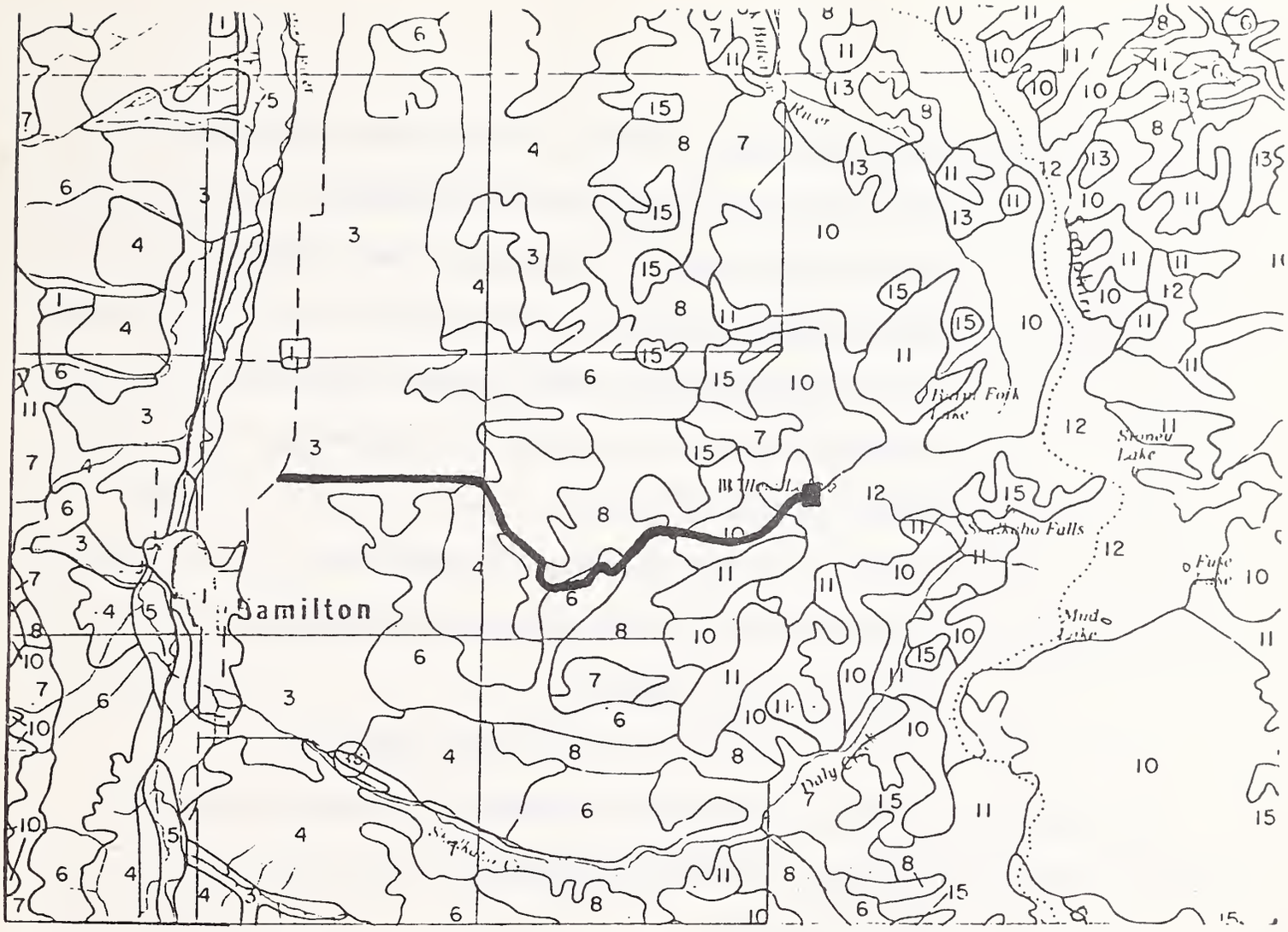


Fig. II-1. Approximate location of mine, access roads, and wildlife habitat types (from Montana Department of Natural Resources, 1976).

(6) Timber/Bunchgrass (limber pine/Bluebunch wheatgrass, Ponderosa pine/Bluebunch wheatgrass, Douglas fir/Bluebunch wheatgrass, limber pine/common juniper, Douglas fir/Kinnikinnic)

(7) PP-DF/Shrub (Ponderosa pine/Snowberry, Douglas fir/Dwarf Huckleberry, Douglas fir/Snowberry, Douglas fir/White spirea)

(8) DF/Grass and Forb (Douglas fir/Beargrass, Douglas fir/Twin flower, Douglas fir/Pinegrass, Douglas fir/Elk sedge)

(10) AF-GF Dry (Douglas fir/Beargrass, Subalpine fir/Dwarf huckleberry, Subalpine fir/Beargrass, Subalpine fir/Gouse whortleberry, Subalpine fir/pinegrass)

(11) AF-GF Moist (Grand fir/Queen cup beadlily, Subalpine fir/Queen cup beadlily, Spruce/Sweet scented bedstraw, Pine/sweetscented bedstraw, Subalpine fir/Bluejoint, Subalpine fir/Twin flower, Subalpine fir/Menziesia, Subalpine fir/Mountain alder, Pine/Twin flower)

(12) Subalpine and Timberline (Subalpine fir, whitebark pine/Grouse whortleberry, Subalpine fir/Wood-rush, Whitebark pine-Subalpine fir, Alpine lark-Subalpine fir, Whitebark pine)

(15) Logged

The Skalkaho Game Preserve is approximately ½ mile east of the proposed

mine. Two-thirds of the Preserve is above 7,000 feet. Subalpine fir, engelmann spruce and whitebark pine are the dominant species of trees at the higher elevations and there is some Douglas fir and lodgepole at lower elevations. Within this generally forested area there are numerous subalpine meadows, parks, and open to partly open slopes which support a cover of grasses, sedges, rushes and an assortment of other herbaceous plants (Burns, 1974).

Appendix B contains canopy coverage and frequency of occurrence of low growing plants (1974 and 1975) for elk winter range transect sites in Hunting District 261, which encompasses the mine site. These transect results provide a plant species list for lower elevations.

b. Periphyton

Periphyton grab samples were collected from St. Clair Creek above the Western Vermiculite Mine at T6N R18W Section 19 on July 18, 1978 (Water Quality Bureau 1978).

Results of the periphyton analysis are presented in Tables II-3, II-4, and II-5. The abundance of aquatic moss is typical of cold, higher elevation waters that are rich in free CO_2. The important algal generea--Chaetophora, Tolypothrix, Diatoma--are also typical of low-nutrient, circumneutral waters. The blue greens that are present are neither bloom forming nor toxic. They are not the kinds associated with eutrophication.

The diatom assemblage was dominated by Diatoma hiemale var. mesodon, which is often associated with springs or seeps that are consistently cool. Most of the diatoms are attached forms, thereby susceptible to siltation and smothering. They indicate relatively silt-free conditions at present. Shannon-Weaver diversity and the number of taxa counted are both indicators of good water quality and healthy biological conditions. The fact that Achnanthes exceed Nitzschia in abundance reveals that dissolved oxygen is at or near saturation

and that nitrogenous organic matter (sewage) is scarce or nonexistent.

These analyses indicate only a slight chance of heavy metals pollution in St. Clair Creek due to mining activities. There is a much greater possibility of and vulnerability to stream sedimentation. Every precaution should be made to keep mine-related sediment from reaching the water course.

2. Aquatic Fauna

a. Macroinvertebrates

Macroinvertebrates are animals without backbones that are large enough to be seen with the unaided eye. They live upon or burrow into the bottom of a stream. Most macroinvertebrates are immature insects, but the group also includes sponges, crustaceans, flatworms, roundworms, earth worms, mites, snails, clams and adult insects. This group of small aquatic animals provides the critical transition between a stream's primary production and its eventual output of higher forms, such as fish. Like Diatoms, these small animals are also excellent indicators of water quality, individually and collectively as expressed in indexes of community structure.

St. Clair Creek was sampled for aquatic insects in July 1978 by the Montana Department of Fish and Game using the kick-screen sampling technique. Aquatic insect data is presented in Table II-6.

The results of this study generally indicate that the stream possesses a diverse benthic fauna composed primarily of pollution sensitive taxa. The terms "pollution sensitive" or "pollution intolerant" are ordinarily used in the context of sensitivity to oxygen-demanding organic waste, but they may also be used in the sense of siltation and susceptibility to suffocation by excessive inorganic sediment.

It should be noted that the dipteran genera from the Lake Creek drainage are pollution sensitive, although the order Diptera is generally considered to

be composed mostly of tolerant or insensitive taxa. "Sensitive" and "intolerant" are used here in the context of the amount or availability of dissolved oxygen in the water. Sensitive animals are normally those that breathe by means of gills and lack special adaptions for adjusting to extremely low levels of dissolved oxygen or for entrapping atmospheric oxygen at the water's surface. As stated before, these animals are susceptible to both oxygen-demanding organic wastes and to excessive sediment on the stream bottom.

b. Fish

During July 1978 St. Clair and Gird Creeks were electrofished by the Montana Department of Fish and Game to determine the species of fish present and a populaton estimate. Results of the electrofishing are presented in Table II-7.

Species encountered were: Westslope cutthroat (Salmo clarki), Dolly Varden (Salvelinus malma), and Brook trout (Salvelinus fontinalis).

Fish populations were sampled on a once-through basis. Work in other areas has shown that catch efficiency is usually about 10 to 30 percent under similar conditions. The true population abundance would therefore be from three to ten times larger than the actual catch shown in Table II-7.

Fish captured were in excellent condition.

Table II-3. Rank and estimated relative abundance of aquatic plants in St. Clair Creek above the Western Vermiculite Mine (T6N R18W Sec. 19) on July 18, 1978 (DHES, 1978)

Plant	Rank	Relative Abundance
Moss	1	Very abundant
Chaetophora (green alga)	2	Abundant
Diatoms (golden-brown algae)	3	Very Common
Tolypothrix (blue-green alga)	4	Common
Nostoc (blue-green alga)	5	Rare

Table II-4 Percent relative abundance of diatom taxa in St. Clair Creek above the Western Vermiculite Mine (T6N R18W Sec. 19) on July 18, 1978 (DHES, 1978).

TAXON	PERCENT RELATIVE ABUNDANCE
Achnanthes exigua	0.6
A. lanceolata	10.4
A. minutissima	1.1
Amphora ovalis	t
A. ovalis v. affinis	t
A. perpusilla	0.6
Caloneis sp.	1.1
Cocconeis placentula	4.4
Cymbella lunata	0.3
C. sinuata	0.3
Diatoma hiemale	t
D. hiemale v. mesodon	40.8
Diatomella balfouriana	0.8
Diploneis oblongella	0.3
Eunotia tenella	1.9
Fragilaria vaucheriae	6.8
F. virescens	13.4
Gomphonema affine	0.6
G. bohemicum	0.6
G. sublavatum	0.6
Hantzschia amphioxys	0.3
Meridion circulare	6.6
Navicula americana	t

Table II-4 Continued

TAXON	PERCENT RELATIVE ABUNDANCE
N. clementis	t
N. cryptocephala v. veneta	0.3
N. (exigua?)	t
N. gottlandica	t
N. graciloides	t
N. minima	1.4
N. mutica v. ?	0.3
N. (notha?)	1.1
N. radiosa	t
N. sp.	0.8
Neidium hercynicum	0.3
Nitzschia dissipata	1.9
Nitzschia hantzschiana	0.3
N. linearis	0.3
N. palea	1.4
Rhopalodia (gibba?)	t
R. (musculus?)	0.8
Synedra rumpens	t

Table II-5. Diatom community structure in St. Clair Creek above the Western Vermiculite Mine (T6N R18W Sec. 19) on July 18, 1978 (DHES, 1978).

Parameter	Value
Cells Counted	365.00
Number of Taxa Counted	30.00
Total Number of Taxa	41.00
Shannon-Weaver Diversity (d)	3.17
Equitability (e)	0.43
Percent Achnanthes species	12.10
Percent Nitzschia species	3.90

Table II-6. Aquatic insects found in St. Clair Creek, July 1978 from kick-screen samples. (Department of Fish and Game, 1978).

Taxa	Number of insects		
	St. Clair Creek at mine site	St. Clair Creek 5.0 Mi. below mine	St. Clair Creek 7.5 mi. below mine
Ephemeroptera (May flies)			
Heptageniidae		11	27
Ephemerallidae		5	28
Baetidae	5	2	13
Trichoptera (Caddis flies)			
Hydrospsychidae		2	3
Rhyacophilidae	4	4	7
Glossosomatidae		5	10
Leptoceridae	2	1	2
Brachycentridae	1	1	
Plecoptera (Stone filies)			
Peltoperlidae		70	90
Nemouridae	6	2	1
Chloroperlinae	2		1
Perlodidae		3	
Coleoptera (Beetles)			
Elmidae			2;
Unknown	1	1	
Diptera (Flies)			
Tipulidae			1
Chironomidae			2
Simuliidae		7	
Planaria		5	23
Annelid			2

Table II-7. Fish population inventories completed in July, 1978 with electro-fishing equipment on St. Clair Creek and Gird Creek (Department of Fish and Game, 1978).

Stream	Location	Approximate river miles from mine	Length of section (ft)	Fish species*	Number	Length range (in.)
St. Clair	Sec. 19 T6N R18W	0	200	no fish captured		
St. Clair	Sec. 32 T6N R19W	5.0	200	WsCt	9	3.9 - 9.0
				DV	2	5.0 - 5.3
St. Clair	Sec. 8 T5N R19W	7.5	500	WsCt	12	2.7 - 9.4
				Eb	5	4.3 - 10.5
				DV	1	5.3
Gird	Sec. 10 T5N R20W	12.5	400	WsCt	12	3.2 - 10.5
				Eb	3	4.8 - 5.5
				DV	1	7.1

* WsCt - Westslope cutthroat, DV - Dolly Varden, Eb - Brook trout.

3. Wildlife

a. Birds

(1) Waterfowl

The only live water in close proximity to the proposed Western Vermiculite operation is St. Clair Creek. No observations of water fowl were made at the mine site. However, a list of species which occur in the ponds, lakes, and drainages of the Sapphire Mountains and Bitterroot Valley and which might occasionally occur on St. Clair Creek is contained in Table II-8 (Flath 1970, Skaar 1975).

(2) Raptors

Fifteen species of raptors are known to occur in and around the area of the proposed development. Species known to occur in this region include accipiters, falcons, harriers, eagles, buteos and owls.

Individual species are the red-tailed hawk (Buteo jamaicensis), the American kestrel (Falco sparverius), the goshawk (Accipiter gentilis), sharp-skinned hawk (Accipiter striatus), saw-whet owl (Aegolius acadicus), great gray owl (Strix nebulosa), Coopers hawk (Accipiter cooperii), great horned owl (Bubo viginianus) and rought-legged hawk (Buteo lagopus) (Skarr, 1975).

(3) Forest Grouse

Blue grouse in the Bitterroot National Forest near Hamilton were studied from 1962-1969 (Mussehl, Schladweiler and Weckwerth, 1971). Some of these studies were controls for grouse/insecticide studies (Mussehl and Schladweiler, 1969).

Mussehl (1963) studied blue grouse brood cover selection about 10 miles southeast of Hamilton. He obtained most brood observations in ponderosa pine types and reported that herbaceous cover was important to brood success. Within that herbaceous cover requirements were: relatively high degree of canopy coverage, adequate effective height, interspersion of plants of varied life forms, and minimum

TABLE II-8

BREEDING STATUS OF WATERFOWL SPECIES
REPORTED FROM THE ANACONDA-HAMILTON STUDY AREA

Species	Status[1]
Whistling Swan (Olor columbianus)	M
Trumpeter Swan (Olor buccinator)	M
Canada Goose (Branta Canadensis)	B
Snow Goose (Chen Caerulescens)	M
Ross Goose (Chen rossii)	M
Mallard (Anas platyrhynchos)	B
Gadwall (Anas strepera)	B
Pintail (Anas acuta)	B
Green-winged Teal (Anas crecca	B
Blue-winged Teal (Anas discors)	B
Cinnamon Teal (Anas cyanoptera)	B
American Wigeon (Anas americana)	B
Northern Shoveler (Anas clypeata)	B
Wood Duck (Aix sponsa)	B
Redhead (Aythya americana)	B
Ring-necked Duck (Aythya collaris)	M
Canvasback (Aythya valisineria)	B
Lesser Scaup (Aythya affinis)	B
Common Goldeneye (Bucephala clangula)	B
Barrow's Goldeneye (Bucephala islandica)	M
Bufflehead (Bucephala albeola)	M
Harlequin Duck (Histrinonicus histrionicus)	B
Ruddy Duck (Oxyura jamaicensis)	B
Hooded Merganser (Lophodytes cucullatus)	B
Common Merganser (Mergus merganser)	B
Red-breasted Merganser (Mergus serrator)	M

SOURCE: Skaar 1975; Flath 1970.

[1] B = breeding, M = migrant or wintering only (Latilongs 25 and 26).

amounts of bare ground. Heavy grazing lowered the suitability of this habitat to brood rearing.

In comparison, Martinka (1972) studied male blue grouse territories in the same study area and found that coniferous thickets were the primary component of breeding territories. Territory size averaged two acres and was determined by the distribution of vegetation, and territorial behavior by males. Both Douglas fir and ponderosa pine thickets were used, depending on density of the thicket, age and size of trees, and amount of understory. Martinka reported that territories could be accurately predicted from discriminant function analysis, using ten variables. Land use practices such as selective logging, might improve habitat, while other practices including clearcutting, slash piling, planting of terraces on clearcuts, and thinning of overstocked tree stands were detrimental.

(4) Other Birds

There are few published studies of birds in the mine locale. A potential list with breeding status (Appendix C) was derived from Skaar (1975); obviously, all the birds listed will not occur in the habitat types affected by the mine. Manuwal (1968) studied breeding birds in coniferous (Douglas fir, lodgepole pine) types of the Lubrecht Experimental Forest, about 60 miles northeast of the mine area; the species he found breeding in those types are marked with an asterisk in Appendix C. These additions may not represent all breeding birds in the locale.

b. Mammals

(1) Rodent-Like Mammals

Two vertebrate taxa are known to be restricted to the Bitterroot Valley area, and are two endemic subspecies of mammals. These are Thomomys tapoides confinus, a subspecies of the northern pocket gopher restricted to the Bitterroot Valley near Hamilton, and Eutamias amoenus vallicola, a subspecies of the yellow-pine chipmunk known only from the vicinity of the Bitterroot Valley and Skalkaho

Canyon (Flath, 1974).

Other species occurring in the general area are: Yellow belly marmot (Marmota flaventris), hoary marmot (Marmota calugata), golden-mantled squirrel (Spermophilus lateralis), columbian ground squirrel (Spermophilus columbianus), redtail chipmunk (Eutamias ruficaudus), yellow pine chipmunk (Eutamias amoenus), red squirrel (Tamiasciurus hudsonicus), northern pocket gopher (Thomomys tapoides), beaver (Castor canadensis), porcupine (Erethizon dorsatum), bushytail woodrat (Neotoma cinerea), deer mouse (Peromyscus maniculatus), boreal redback vole (Clethrionomys gapperi), mountain phenacomys (Phenacomys intermedius and snowshoe hare (Lepus americanus) (Hoffman and Pattie, 1968).

(2) Carnivores

The Montana Legislature has classified many of the species in this Order (Carnivora) as game animals, furbearers or predators for management purposes. Those species which are not so designated are simply referred to as unclassified. Furbearers include those species which have a valuable hide and are protected by law. On occasion pelts of predators and unclassified animals have had higher fur value than furbearers (Mitchell, et. al. 1971).

Carnivores known to inhabit the general area are: black bear (Ursus americanus), mountain lion (Felis Concolor), bobcat (Lunx rufus), and coyote (Canis latrans).

Members of the Mustelidae (Weasel) family occurring in this area include: marten (Martes americana), mink (Mustela vison), longtail weasel (Mustela frenata), striped skunk (Mephitis mephitis), and wolverine (Gulo gulo). The fisher (Martes pennanti), once extinct from Montana, has been successfully reintroduced in the Sapphire Mountains and a small population is known to exist there today (Hoffman and Pattie, 1968).

(3) Ungulates

Ungulates occurring in the general area of the proposed operation are: elk (Cervus canadensis), moose (Alces alces), mule deer (Odocoileus hemionus) and mountain goat (Oreamnos americana) (Montana Department of Fish and Game, 1978).

(a) Elk

Elk winter range, 4-8 miles west of the mine site, is about 80 percent privately owned. The Montana Department of Fish and Game owns 2,000 acres of winter range between Willow Creek and Charleys Gulch. The western two thirds of the winter range is the major foraging area and is composed of mixed bunchgrasses and forbs with stringers of Douglas fir and Ponderosa Pine on the north slopes of drainages and draws. Conifers, mainly Douglas fir and Ponderosa Pine, dominate the eastern one third of this winter range and provide security and protection from weather, etc. (Montana Department of Fish and Game, 1978).

Dual use of the winter range by elk and livestock does occur resulting in forage competition in some areas. Winter-spring elk use of bunchgrasses varies from 35-65 percent annually. Range conditions have been rated from fair to good on those portions of the winter range sampled by vegetation transects.

Elk production and survival of calves has been good to excellent (40-50 calves/100 cows) since 1970. Some calving does occur on the winter range in the timbered draws. Although total populations are unknown, 350-475 elk are counted annually on winter range between Willow Creek and Skalkaho Creek. Populations have been generally stable since 1970. Elk harvest rates fluctuate considerably depending on fall weather conditions. With no hunting allowed in the Skalkaho Game Preserve and the Bitterroot Stock Farm, hunters must "catch" the elk moving from the Preserve to winter range on and adjacent to the Stock Farm. During those years with mild fall weather, few elk leave the Preserve during the hunting season and harvests are low.

Generally by mid to late May most elk have left the winter range for the higher elevation summer range. They move with the receding snow and calves are dropped between winter and summer range. Calving does occur in the vicinity of the mine.

The mine is within summer-fall range; however, the majority of elk use is concentrated from one to four miles east, mainly in the Preserve. Summer forage utilization by elk in the open basins of the Preserve has averaged 40-60 percent during the last 10 years. Rutting activity is very heavy within the Preserve and evidence of rutting near the mine has been observed (wallows, scraped trees, etc) (Montana Department of Fish and Game, 1978).

(b) Mule Deer

Mule deer populations are smaller than the elk but have been increasing during the last two years, due mainly to an increase in fawn survival. Range use for mule deer is similar to that of elk with the exception that they are much more scattered on the summer range (Montana Department of Fish and Game, 1978).

(c) Mountain Goat

Chet Rideout (Montana Department of Fish and Game) conducted a four-year goat study in the Dome-Shaped Mountain area approximately six miles northeast of the mine from 1970-1973. Lincoln index estimates of the population of this herd varied from 65-77 goats. Some goat activity, including marked animals, was observed on Skalkaho Mountain, within one mile of the present mine site.

(d) Moose

This species occurs in limited numbers in the vicinity of the mine. No concentration of animals or isolated areas of key habitat occur near the mine site, and it is expected that impacts on these animals from habitat destruction and activities associated with the mining operation will be minimal (Department of Fish and Game, 1978).

(4) Endangered or Threatened Species

Certain wildlife species are provided with protection by the (U.S.) Endangered Species Act of 1973, and the (State) Nongame and Endangered Conservation Act of 1973. Those species include the Grizzly bear, peregrine falcon, bald eagle and gray wolf. Of these species, only the bald eagle and the peregrine falcon occur in the general area of the proposed action. The peregrine falcon passes through the Sapphire mountains area during migration, and although it has previously nested in the Sapphire mountains, no currently active eyries are known. The bald eagle may occasionally pass through the area, although the site of the proposed mine is not in known bald eagle habitat and no sightings of a bald eagle have occurred on the area proposed for the mining project (pers. comm., John Firebaugh, Dept. of Fish and Game).

Several status-undetermined species occur in the general area, including the marten, fisher, wolverine, ferruginous hawk, osprey and merlin. No threatened species are known to exist in the area.

C. The Social and Economic Environment

1. Introduction

The existing economic and social environment into which the Western Vermiculite project would be interjected consists of a number of facets. These include the local economy, population, transportation routes, land use, social structures and a wide range of social services.

2. Local Economy

Historically the primary components of the economy of Ravalli County have been agriculture, manufacturing (including forest products), government, retail services and the retirement industry. These components produce more than 80 percent of the income, salaries and wages within the county.

Agriculture production in the county is responsible for nearly 20 percent

of the dollar volume in the local economy. This figure compares favorably to the state-wide figure of 11 percent of total personal income from agriculture.

From a gross dollar standpoint, the impact of government expenditures and payrolls is the second most significant sector of the county's economy. In terms of total expenditures, this sector represents over 20 percent of the areas economy. The two largest government agencies are the U.S. Forest Service and the Rocky Mountain Laboratory.

Manufacturing, including the harvesting and milling of timber, produces sales of over eight million dollars per year in the county. It ranks about fourth in economic importance from a gross dollar standpoint. State-wide manufacturing ranks fifth in personal income generated, and second in gross receipts. In Ravalli County, the timber industry constitutes about half of all manufacturing gross dollars, and two-thirds of the manufacturing employment.

From a gross dollar standpoint, retail business in the county is the largest economic activity. In 1972, it accounted for $28,879,000 in sales and nearly 600 employees.

The economic impact of retired or semi-retired persons is a significant part of the county's economy. A recent study on the economic structure of the county (Ravalli County, 1975) estimated that "the retirement industry brought more than twice as many dollars into the Bitterroot Valley as did manufacturing and mining combined." If this is in fact the case, retirement would be close to the number one industry in the county.

3. Population

According to the Bureau of the Census, Ravalli County had a 1970 population of 14,409 or a 16.8 percent growth increase over the 1960 population of 12,341. This rapid growth is unlike the growth of the past thirty years in that it has occurred despite continued declines in the agricultural base. This growth

period also coincides with the rather dramatic increase in subdivision activity throughout the county that has continued to increase through 1978.

The county is undergoing a changing population character and distribution pattern. The rural farm population declined from a high of 7,313 in 1940 to 2,875 in 1970, while nonfarm population rose from 5,665 to 11,528 during the same time period. The percent of rural farm population has decreased from 44.2% in 1950 to 19.3% in 1970. The corresponding rural nonfarm population increased from 35.3% to 80.7% in the same time period.

4. Land Use Planning

In a 1975 report prepared for Ravalli County, goals and objectives for land use were proposed. These are:

Goal A: To maintain and enhance the natural resources, economic potential, scenic, recreational and environmental qualities of Ravalli County through the development of an orderly growth and land use pattern. In achieving this goal, sufficient land will be allocated to accommodate the needs of residential, commercial, industrial and agricultural uses, based upon the suitability and desirability of land for such uses.

Objectives:

1) To maintain existing land uses where they are compatible with future needs.

2) To discourage future land uses where they are incompatible with the best use of the land in terms of social, economic, engineering and ecologic and planning principles.

3) To prepare and adopt a set of development policies to serve as a basis for guiding.

4) To consider and if necessary establish zoning as a possible tool to guide future land use decisions in the county.

Goal B: To protect, encourage and support the agricultural base of the county and its agricultural resources.

Objectives:

1) To reserve "prime agricultural" land specifically

for continued agricultural uses.

2) To develop means of encouraging and expanding productive agricultural activities in the county.

Forest Service management direction for the lands in and around the proposed mine site are as follows (USFS 1974):

> *Manage this unit with the emphasis on the recreational, wildlife, water, and visual values present. Timber management activities and associated road construction, where compatible, will be conducted on an extensive basis.*

Forest Service management guidance for these lands is as follows:

1) Manage the corridors, along all roads open to public use, as separate units. Permissible activities in each corridor will depend upon stand conditions and the presence and degree of past activities. Quality, diversity, and variety of traveler viewing experiences will be emphasized.

2) Postpone any timber management activities in the mineralized portion of St. Clair Creek until mineral development takes place. At that time, coordinate timber harvest with essential mineral development to best protect the aesthetic value of the area.

3) Develop a fuel management plan for this unit. Implement portions of the plan with timber sales as opportunities arise.

4) Whenever feasible, include both sawtimber and pulpwood in timber sale contracts to reduce slash disposal problems and provide the maximum amount of raw material to industry. In all cases, yarding of unutilized material (YUM) will be required.

5) In all activities, provide protection for the important elements of big game summer range, such as bogs and wallow areas.

5. Social Services and Public Facilities

a. Housing

According to the "Detailed Housing Characteristic" compiled by the U.S. Bureau of Census, there were a total of 5,333 housing units in Ravalli County in 1970. This was an increase of 815 over the 1960 supply (Ravalli County, 1975).

Of the number of dwelling units in 1970, 3,548 (70%) were owner occupied

and 1,177 (22%) rented. More than 70% of the housing stock in the county was built before 1949. A total of 162 units (2.7%) of the housing stock was available for sale or rent. This is substantially below the recommended 10% housing vacancy level.

b. Transportation

Mine and mill site access is gained from Forest Service Road 716 which is proposed as a standard 24 foot wide earthen base type. Portions of this road cross private property, and permission must be granted by the landowner before using the road. This road will be upgraded by Western Vermiculite to safely accommodate anticipated mine traffic.

Forest Service Road 716 joins county highway 380 which is a 24 foot wide paved road. This highway leads 4 miles west and joins State Highway 269 which is also a 24 foot wide paved all weather road. These two highways would be used by the trucks hauling the vermiculite ore to the rail siding at Victor.

The major transportation route in the Bitterroot Valley is U.S. Highway 93 which traverses that valley from north to south along its entire length. State Highway 269 joins U.S. Highway 93 at Hamilton.

c. Schools

Current enrollment, as of October 3, 1978, in Ravalli County schools nearest the proposed mining project is contained in the following list:

Town	Elementary	High School
Hamilton	928	588
Corvallis	516	254
Victor	180	116
Darby	461	193
Stevensville	571	418

Total enrollment in all Ravalli County schools has increased from 4,670 pupils during the 1976-1977 school year, to 5,009 pupils during the 1978-1979 school year. This represents a 7.2 percent increase. During the same period,

there was a 20.1 percent increase in the teaching staff from 248 during the 1976-1977 school year to 298 during the 1978-1979 school year. Most of the schools in the county are nearing an overcrowded situation, with the exception of the Hamilton school system. Increasing housing development in the Bitterroot Valley has been the primary cause of the rise of county school enrollment (Superintendent of Schools, Ravalli County, Pers. Comm., 1978).

6. Archaeological and Historic Sites

Forest Service records and records of the State Historical Preservation Office do not indicate the presence of any known archaeological or historic sites that would be disturbed by the Western Vermiculite proposed operation.

The Bitterroot National Forest conducted a site-specific survey of the proposed mining operation area in the summer of 1978 and found no archaeological or historical resources present. One existing historic site occurs adjacent to the mine site. The Forest Service designation number for this site is 24RA47. The site is a historic mining marker and is located approximately one mile southwest of the proposed mine site.

7. Recreation

Recreation facilities and activities in the Hamilton area are primarily outdoor oriented. Local existing urban recreation facilities include parks, play areas, and facilities for organized sports. The mountainous terrain with its associated streams, lakes, forest cover and big game animals contribute to this outdoor orientation both summer and winter.

Dispersed recreation is the primary form of recreation that takes place in the vicinity of the proposed mine and mill areas. Activities include hunting, fishing, hiking, and gathering forest products.

8. Visual Resource

The proposed mine and mill site are located in the upper St. Clair Creek

drainage in an area typical of timbered mountainous terrain in the Sapphire Mountain Range. The area has a high visual quality and is viewed primarily from areas of higher elevation to the east along the mountain range, and areas along the St. Clair Creek drainage. The St. Clair Creek drainage is shielded from view from the Bitterroot Valley by a ridge along its western boundary.

The area of the proposed mine is presently disturbed as a result of past mining activities, although, to a large extent, the visual evidence of past disturbance has been reduced by natural revegetation of the area. An existing road is present to the mine site.

III. ENVIRONMENTAL IMPACT OF THE PROPOSAL

A. The Physical Environment

1. Topography

a. Mine Site

Impact on the existing topography of the ABM Ridge would be the leveling and benching of the ridge. The resulting topography would be more rounded than the original steep ridge (Figures I-1 and I-2).

b. Mill Site

The natural topography of the area would be changed from the original sloping saddle to a benched cut configuration as shown in Firure I-2.

c. Access Road

If the Forest Service decides to maintain the mine access road following completion of the mining project as an extension of the existing Forest Service road system, it would result in long term cut banks and fill slopes on the existing topography. If the road is reclaimed as proposed by Western Vermiculite, impact to the topography would be minimal and short term.

2. Climate

The proposed operation would not result in an alteration of the existing climate.

3. Air Quality

Total suspended particulate levels in the vicinity of the mining project would be expected to increase, primarily as a result of activities at the mine and mill site, and associated vehicle traffic.

The actual mine site is not expected to create any significant long term impact on air quality due to the absence of blasting and the limited amount of heavy equipment activity. There may be some local increases in total suspended Particulate arising from ore removal and loading in addition to ore hauling

along the dirt access roads. These increases would be expected to be short term in nature and confined to the immediate area of the mine, mill site, and access roads.

Operations at the mill site itself would be expected to result in certain emissions of particulate matter and other pollutants to the atmosphere. The impact of these emissions would be largely restricted to the mill and immediate area. Western Vermiculite plans to employ a bag-house dust collector. The use of such a collector would result in negligible emissions from the operation of the mill itself. The addition of minor amounts of other pollutants to the air, such as sulfur oxides and nitrogen oxides, would result from the combustion of diesel fuel by stationary and mobile sources in the area.

4. Geology

With the exception of the physical removal of a portion of the vermiculite deposit, resulting in a reduction of identified mineral resources, the proposed project would have no direct impact upon the geology of the area.

5. Soils

The impact to soils resulting from the mine and mill site would primarily involve a redistribution and mixing of existing soils caused by the removal and stockpiling of the topsoil or top 12 inches of soil for reclamation purposes. Other potential impacts to soils in the immediate vicinity of the mine and mill sites would be soil compaction by human and heavy equipment activity and soil erosion from areas disturbed during construction activities and areas not revegetated during the project life.

6. Water Resources

Analysis has shown that the normal operation of the proposed mine and facilities would not result in a significant adverse impact to the areas existing surface and subsurface water resources. The major potentials for impact to

existing water resources of the area as a result of the proposed project would include; (1) an increase in stream sedimentation during the construction of the mill site and the actual mining and (2) an increase in stream sedimentation by erosion of the topsoil stockpile if reseeding measures failed and (3) an increase in stream sedimentation by erosion and runoff from the mine and mill sites if reclamation efforts failed.

B. The Biological Environment

1. Flora

The major impact to the vegetation of the area as a result of the proposed project would be the direct removal of vegetation during the construction of the mill site and the mining of the vermiculite ore.

Removal of vegetation and its loss of productive capacity would not be permanent at either of the sites with the possible exception of the access road. Reclamation, would return those areas disturbed during the life of the project to a productive capacity.

a. Mine Site

Mining of the ABM Ridge site would remove approximately 20 acres from production for the life of the project. Impacts to timber would be minimal as timber production potential and value in this area is rated as low. There would be no permanent loss of potential vegetation production with reclamation.

b. Mill Site

Construction of the mill site would remove approximately 4 acres from production for the life of the project. Impacts to timber would be as those described for the mine site. Removal of timber in this area would increase the amount of vegetation species used for grazing. The surface owner of the mill site has requested that the site be reclaimed to grazing land. There would be no permanent loss of potential vegetation production if reclamation is successful.

2. Aquatic System Productivity

The cumulative effect of anticipated Western Vermiculite activities, facilities and operations on aquatic productivity should not be significant provided reasonable precautions are taken to contain sediment from disturbed land areas and assuming that acid or toxic waters are not encountered in the mining process.

The state's policy of nondegradation of existing high quality water (Section 69-4808.2) will apply to waters of the St. Clair Creek drainage. This policy reads as follows:

(iii) The board (of Health) shall require that any state waters, whose existing quality is higher than the established water quality standards, be maintained at that high quality unless it has been affirmatively demonstrated to the board that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of these waters; and

(iv) The board shall require any industrial, public or private project or development, which would constitute a new source of pollution or an increase source of pollution to high quality waters, referred to in subsection (iii) to provide the degree of waste treatment necessary to maintain that existing high water quality.

A measurable change in water quality, including a change in aquatic productivity that might affect a beneficial use, will be subject to enforcement action by the Department of Health and Environmental Sciences.

Potential impacts on aquatic productivity from the actual mining operation can be categorized as suspended solids resulting from disturbed land surface and mine access roads.

Suspended solids and turbidity would have the effect of obscuring light

needed for photosynthesis and of smothering benthic aquatic organisms if sediment cannot be contained before it reaches St. Clair Creek, which appears to be a perennial stream at the site of the proposed operations. The potential for sediment generation from the mine site would be significant, however, given reasonable precautions to contain it, it is unlikely that a large amount of sediment would find its way to St. Clair Creek.

Of the proposed activities, the construction of the mine access road and mine site preparation would have the greatest potential to generate increased sedimentation because of the proximity to St. Clair Creek. Acid mine discharge and the probability of encountering a body of toxic water in the mine are both very unlikely.

Most of the macroinvertebrates in the drainage are pollution intolerant and sensitive to sediment. The relatively pristine waters of the St. Clair Creek drainage have high diversities of macroinvertebrates and any significant change in water quality probably would result in a simplification of their benthic communities.

Adverse impacts to periphtyon and macroinvertebrates would have a similar adverse impact upon the aquatic systems's higher consumers, fish. It is not anticipated that the normal operation of the proposed facilities would adversely affect the fisheries of the area. During the construction of various facilities, the greatest risk for impact to the fisheries would originate with the potential for increased sediment transport into surface waters. Habitat alteration caused by sediment and sedimentation would, for the most part, be short-term, occurring during and immediately after construction activities.

Sediment affects fish directly by reducing visibility, limiting the ability of the fish to locate food sources, clogging of gills by particulate matter and abrading external structures by the action of suspended solids (Phillips

1970, Sanders 1967 and Chapman 1962). The extent and magnitude of these impacts would be dependent upon many variables, including species, age and general health of the fish affected, water quality, the length of exposure to sediment, sediment particle size, shape hardness and frequency of particle introduction.

Most authors conclude that concentrations of suspended solids must be very high to cause direct mortality of fish; in most cases, indirect damage to the fish population through destruction of the food supply, eggs or fry, or changes in the habitat probably occur long before the adult fish are directly harmed. Mortality of fish eggs caused by sedimentation is well-documented (Elser and Marcoux 1971, Sanders and Smith 1965 and Bianchi 1963). Clean permeable gravels provide nursery areas for fish embryos in the stream environment. Sediment in the water during the incubation period can greatly reduce the survival rate of developing embryos by clogging the pore spaces between the gravels. The supply of oxygen necessary for successful embryo survival diminishes, resulting in high embryo mortality (Peters 1962).

After hatching, fish fry depend on the crevices and interstices in the gravel along the stream bottom for cover and security from predators. Sedimentation can fill these spaces, eliminating escape cover. Phillips (1970) suggests that this increased vulnerability to predators may contribute to increased fry mortality.

The adult fish populations of St. Clair Creek could be seriously affected if excessive sediment accumulation were to fill important pool areas, reducing available cover and hiding places (Sanders and Smith 1965). Bjornn et. al. (1974) working in Idaho, concluded that the summer and probably the winter, capacity of small mountain streams, where most trout reside in pools, will be reduced if sufficient sediment is added to a stream to reduce pool area or

volume.

In addition to the direct impact potential as identified above, the sport fisheries of the general area may also experience indirect adverse impacts related to increased fishing pressure.

3. Wildlife

a. Elk and Deer

Potential impacts to elk and deer occur in two ways; habitat destruction from the mine and the various disturbing activities associated with the mine and road access.

In the short run, habitat destruction does not appear to be a major threat to elk populations. Since a maximum of 30 acres can be disturbed during the next seven years under the permit, and since much of the mine area has already been disturbed from previous mining activity resulting in little vegetation regrowth, little habitat will be destroyed.

The processing plant located at the head of Charleys Gulch is at a high enough elevation to preclude much disturbance to elk during a normal winter. However, during mild winters and other seasons, the proposed 24 hour operation and activity would effect elk distribution and utilization of the surrounding habitat.

Additional winter traffic on the winter range portion of the Charleys Gulch Road (approximately seven miles) will probably disturb elk. Increased disturbances during winter create additional stress on animals and may result in this portion of winter range not being utilized. As elk are displaced to other portions of the winter range, more competition for an already limited forage supply will occur.

b. Mountain Goat

Little impact to mountain goats can be expected at the present mine location. However, if expansion of mining activities occurs in the future, the potential exists for disturbance to mountin goats and their habitat. Some goat activity, including

marked animals, was observed on Skalkaho Mountain, within one mile of the present mine site. Vermiculite has been found on Skalkaho Mountain, within one mile of the present site, and if this proved economically feasible to extract in the future, mountain goat habitat could be lost. Since goat habitat is limited in this area, loss of habitat would mean a reduction in the mountain goat population and the carrying capacity of the habitat.

c. Moose, Black Bear, and Mountain Lion

Each of these species occurs in limited numbers in the vicinity of the mine. No concentration of animals or isolated areas of key habitat occur near the mine site, and it is expected that impacts on these animals from habitat destruction and activities associated with the mining operation will be minimal.

d. Other Mammals

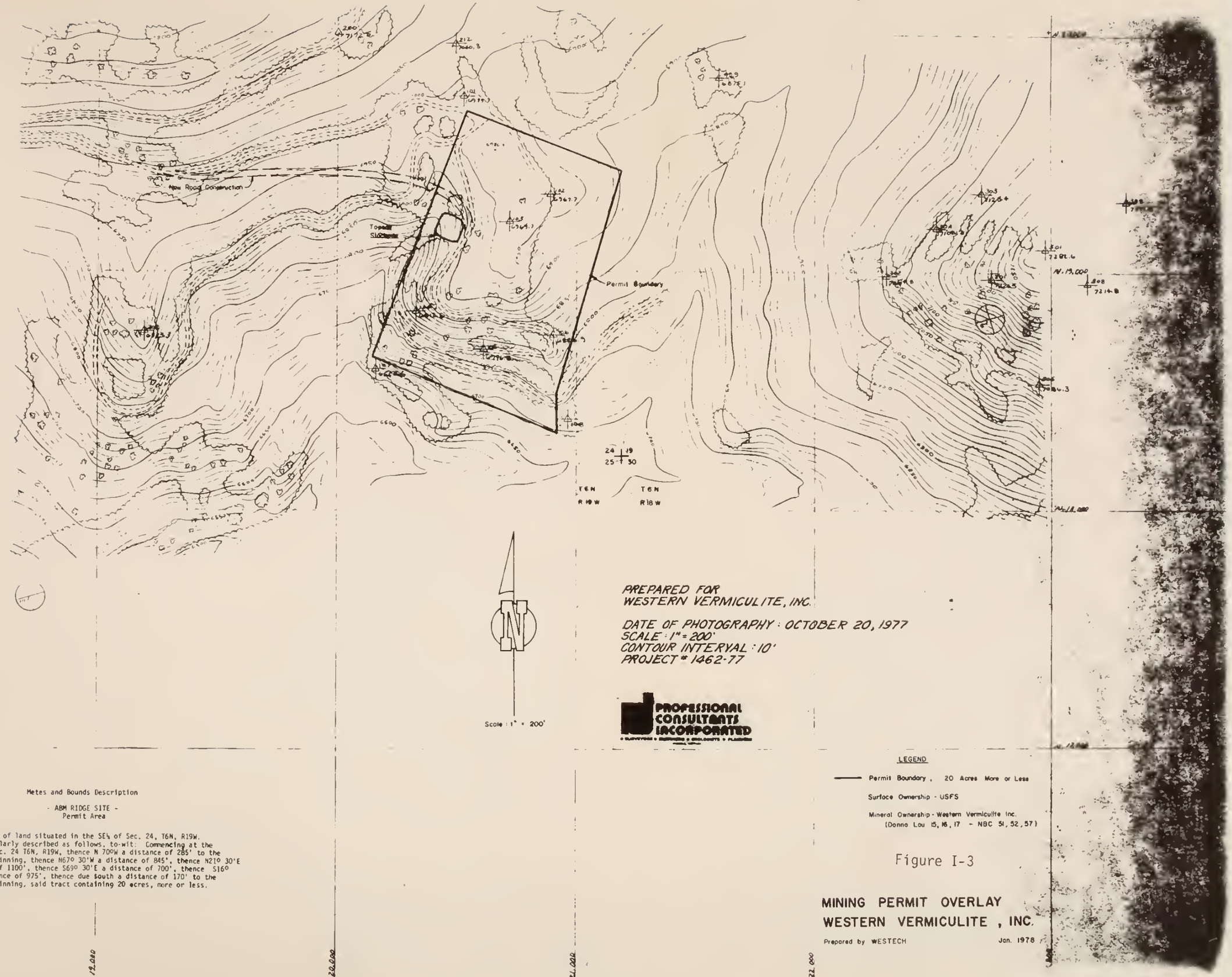
Little impact to other mammalian species is expected to occur during normal operation of the mine and mill. The major potentials for impact to these species include; (1) displacement of these species by activity associated with operation of the mine and mill and vehicle traffic and (2) loss of habitat during the life of the mine by removing the ABM Ridge deposit and clearing of the mill site. Providing that reclamation is successful, this habitat loss will be of a temporary nature.

e. Waterfowl

As there is no live water at the mine or mill site, little impact to waterfowl is expected. Potential impact to waterfowl would be displacement of species by activities and noise associated with mining and milling processes.

f. Forest Grouse

Potential impacts to forest grouse would include displacement by noise and activities of mining and milling and loss of habitat for the life of the mine by removal of vegetation at the mine and mill sites. As the four acres to be removed



PREPARED FOR
WESTERN VERMICULITE, INC.

DATE OF PHOTOGRAPHY : OCTOBER 20, 1977
SCALE : 1" = 200'
CONTOUR INTERVAL : 10'
PROJECT # 1462-77

PROFESSIONAL CONSULTANTS INCORPORATED

Metes and Bounds Description

- ABM RIDGE SITE -
Permit Area

A tract of land situated in the SE¼ of Sec. 24, T6N, R19W. More particularly described as follows, to-wit: Commencing at the SE corner Sec. 24 T6N, R19W, thence N 70°W a distance of 285' to the point of beginning, thence N67° 30'W a distance of 845', thence N21° 30'E a distance of 1100', thence S69° 30'E a distance of 700', thence S16° 40'W a distance of 975', thence due South a distance of 170' to the point of beginning, said tract containing 20 acres, more or less.

LEGEND

Permit Boundary , 20 Acres More or Less

Surface Ownership - USFS

Mineral Ownership - Western Vermiculite Inc.
(Donna Lou 15, 16, 17 - NBC 51, 52, 57)

Figure I-3

MINING PERMIT OVERLAY
WESTERN VERMICULITE , INC.

Prepared by WESTECH Jan. 1978

for the mill site are proposed to be reseeded to native grasses, there will be a temporary loss of tree cover, however, this is an insignificant amount when compared to the remaining forested acreage.

C. The Social and Economic Environment

1. Employment and Population Effects

Western Vermiculite Company proposes to hire the work force from the Hamilton and surrounding area. Due to this hiring from the existing unemployed work force the impacts upon the population and housing are considered insignificant.

2. Government Revenue and Expenditure Impacts

a. Revenues

There are four major sources of revenue resulting directly from taxation of the Western Vermiculite development. These sources are as follows: Property Tax, Resource Indemnity Trust Tax, Micaceous Mineral Mines License Tax and Corporation License Tax. The first two are earmarked for use primarily by local governments and are collected by the county treasurer. The others are collected by the State Department of Revenue for statewide purposes.

b. Property Taxes

The facilities including equipment and land of the Western Vermiculite project would be subject to a property tax levied by Ravalli County. The proceeds primarily would help fund the Hamilton school district and Ravalli County.

(1) Property Tax Revenue

The property taxes generated by Western Vermiculite Company are estimated to be minimal due to the small acreage involved and the majority of the land being on National Forest.

Although an actual calculation of personal property taxes has not been made it has been estimated at approximately $20,000 per year (Western Vermiculite, 1978).

(2) Resource Indemnity Trust Tax

The Resource Indemnity Trust Tax is levied annually on all mining activity in Montana. The tax rate is $25.00 plus one-half of 1 percent of the gross value of production in excess of $5,000. This tax depends on the market price of the mineral extracted. The tax receipts are deposited in the State Resource Indemnity Trust Account of the Trust and Legacy Fund. Monies in this trust account are invested by the State Board of Investments.

The purpose of the fund is to make money available to improve the total environment and rectify damage caused by mining operations. The fund and investment earnings remain intact until their total reaches $10 million. At this level, the investment earnings can be expended for the purpose mentioned above. Once additional tax receipts expand the fund to $100 million, both the investment earnings and any additional tax receipts can be expended to rectify environmental damage caused by mining.

Using the current average market price for vermiculite of the grades to be mined of $65 per ton, Western Vermiculites estimated Resource Indemnity Trust Tax per annum is $32,500.

This tax will not necessarily benefit Ravalli County. However, it may be utilized should environmental damage occur that is caused by the mine operation and is not satisfactorily corrected by Western Vermiculite.

(3) Micaceous Mines License Tax

The Micaceous Mines License Tax is collected by the Department of Revenue for the State of Montana. This tax is based on the gross value of annual production and is levied on a graduated basis, increasing as the gross value of production increases. The tax rate is 5 cents per ton. Estimated annual tax for Western Vermiculite is $5,000.

(4) Corporation License Tax

Similar to the Micaceous Mines License Tax, the Corporation License

Tax is levied by the State of Montana. The license fee is measured by the corporations annual net income derived from or attributable to Montana sources. Thus, it is really a corporate income tax. The rate is 6.75 per cent of net income with a minimum payment of $50.00. The projected tax for Western Vermiculite Company for the first two years would be only the minimum payment of $50.00. Projected tax after this period is not available at this time but is not expected to be significant.

(5) Other Revenue Source

Extra tax revenue sources could be: property taxes on new houses, personal property taxes, personal income taxes, motor vehicle license fees, drivers license fees, etc. The taxes generated from these areas are minimal as the work force to be utilized will be secured from the local area.

(6) Expenditures

The Hamilton and surrounding areas will not have a significant number of new residents to assimilate as the majority of the workforce will be taken from the existing population. Therefore, expenditures for public services will be insignificant.

(7) Personal Income Effects

The median family income in Ravalli County in 1970 was $7,137. The average employee earnings at the Western Vermiculite operation is approximately $15,000.

The impact of the personal income generated by the Western Vermiculite operation on the Ravalli County income, although positive in nature, would be considered minimal when assimilated by the county population of approximately 18,500 (Department of Community Affairs, 1975).

3. Social Services and Public Facilities

a. Housing

As the work force to be employed at the mining and milling operation will be

secured from the existing work force at Hamilton and surrounding areas and they already have housing arrangements the impact upon housing would be minimal.

b. Schools

Similar to the above conditions the impact to existing schools would be minimal as assimilation of the majority of the students from the work force has already occurred.

c. Recreation

Impacts to the existing recreation sites would be minimal as the present sites would be able to accommodate the minimal additional use without a significant reduction of the recreational experience.

d. Public Safety

At present there is sufficient police and sheriff personnel to provide adequate services for the existing population. Since the majority of the work force is to assimilated from the existing population, where the ratio of law enforcement personnel is 0.99 per 1,000 population, the impact to public safety will be minimal as in-migration of mine personnel will be insignificant.

e. Health Services

The existing hospitals, emergency services and ambulance services of Hamilton and surrounding area would receive minimal impact due to the insignificant in-migration of workers to the mine.

f. Transportation

The majority of personal travel and movement of freight to and from the proposed operation would be by car and truck. Increased car, truck and heavy ore hauling trucks would result in increased wear on County Road 269 and on Forest Service Road 716. The Forest Service road would be constantly maintained by Western Vermiculite for their operation resulting in impacts of an in-significant nature. An increase in maintenance of County Road 269 would be incurred

although this would probably be minimal.

g. Aesthetics

The proposed mining development is not within viewing from Hamilton or any major transportation route, therefore, the visual impact would be slight. Hikers, backpackers, hunters and other off-road travelers may encounter the mine and mill operation but, a heavy cover of trees minimizes visual impacts of the milling operation. The low profile and small amount of equipment and disturbance at the mine site would also be minimal in nature.

h. Archaeological and Historic Sites

There would be no direct impact to any known archaeological or historic sites by the proposed mining development. Although surveys to date do not show any archaeological or historical sites within the project area, care would have to be taken to preserve and evaluate any hidden sites uncovered during the development of the project.

D. Adverse Impacts That Cannot be Avoided if the Proposal is Implemented

Mining would decrease the stability on about 30 acres of reclaimed land surface, thus resulting in increased erosion and deposition in the permit area if reclamation fails.

Although the proposed project would result in an unavoidable alteration of the existing topography in the mine and mill areas, the alteration is not considered to be significantly adverse.

The proposed development would result in increased activity in the area and would unavoidably result in some deterioration in air quality. The deterioration, however, would be primarily limited to short-term increased level of total suspended particulates and is not considered significantly adverse.

Successful completion of the mining and milling activity would result in a

reduction in the known domestic vermiculite reserves.

The productive capacity of approximately 30 acres of native soil to produce native vegetation and wildlife habitat would be lost for the life of the proposed project.

The normal operation of the proposed facilities would not result in a significant impact to the areas water resources.

Construction and operation of the proposed mill site would require the removal of 4 acres of native vegetation for the life of the project.

Road construction and reconstruction could be considered a negative impact to visual resources.

E. Relationship Between Short-Term Uses of Man's Environment and the Maintenance of Long-Term Productivity

The following discussion appraises the extent of long-term impairment or enhancement of resource values that would occur, given the proposed short-term mining of vermiculite in the Hamilton area. In this analysis of trade-offs over time and trade-offs among resource values, short-term refers to that period of approximately seven years during and immediately following the proposed operations when mining and reclamation are to take place. Long-term is that period thereafter during which consequent impacts, both adverse and beneficial, still affect the environment.

1. The Physical Environment

The proposed mining and milling activity represents a short-term productive use of the mineral reserves. The long-term effect on the productivity of the locatable mineral resource present will be a decrease in productivity until the mineral resource of the mine is totally depleted.

Soil disturbances on approximately 30 acres as a result of the proposed action would alter soil characteristics and probably cause some short-term

decline in soil productivity. Soil losses would occur from erosion on denuded and distrubed areas during operation and reclamation. Also, organic content and biological activity in the replaced surface layer would be decreased by mixing soil and by stockpiling. Although there may be some minor changes in the soil productivity, permeability, infiltration and depth, the basic soil characteristics would be present to sustain the long-term productivity of the soils.

2. The Biological Environment

At no time would the entire area proposed for disturbance be devoid of vegetation, inasmuch as reclamation activities, particularly those which relate to control of erosion, would, to the extent feasible, be conducted simltaneously with mining and in any case would be initiated promptly after completion or abandonment of mining on those portions of the mine complex that would not be subject to further disturbance by the mining operation (Section 9 (50-1209) (a) of the Montana Hard Rock Law). Given successful reclamation, the productivity of the disturbed acreages should be interrupted only for the time required for mining operations to be completed and for permanent revegetation to occur. If reclamation is not successful on all or any part of the disturbed areas, then the long-term productivity of the vegetation resource will have been partially sacrificed for the short-term benefits that the mineral resource provides.

Vegetation on areas that have been utilized for roads or facilities may not return to a permanent, diverse cover within the near future (short-term) as a prolonged time period is required for succession to occur. Diversity, however, is not necessarily a requirement for a productive vegetation resource.

Forest-dwelling species would not realize any benefits, and many open country species, which positively respond to habitat alteration (such as over-story removal) would realize few, if any , benefits from the development of the mine and it's facilities.

3. Social Environment

This new development may bring added support for the social environment which many residents believe has been gradually deteriorating because of the lack of employment opportunities, public revenue resources and stimulus for economic prosperity. The productivity of the mining operation may help to resolve deficits and as a result, improve or maintain the social values of the area as they now exist.

4. Economic Environment

Ravalli County's economic environment would undoubtedly receive stimulation through new employment and mining production. The mining activity would bolster the existing commerce in Ravalli County. Thus, the short-term consequences of the mining lifetime would be favorable.

If mining were to terminate at the end of the seven year period proposed, the long-term effect would be the probable return to a less stable economy possibly similar to the existing economy.

5. Archaeological and Historical Sites

Archeological and historical sites or artifacts are nonrenewable and hence long-term resources. In the event that significant sites are not discovered and are destroyed during the mining process, the physical resource loss would be irretrievable. In addition to such a possible loss of physical resources, educational and scientific information regarding prehistoric environments and our cultural heritage would also be lost to both present and future generations.

F. Irreversible and Irretrievable Commitment of Resources

1. Mineral Resources

The proposed mining and milling activity would irreversibly commit the vermiculite ore body to depletion. Mineral deposits are unique, highly finite and valuable features of the earth's crust, formed by slow processes still active today.

Mining of the mineral resources is a depletion of a resource that will require millions of years to be replenished, possibly never (localized) in the same area.

This depletion must be considered in two phases: 1) the raw mineral resource in the ground and 2) the finished product mineral resource in use. The proposed action would reduce the mineral resources of the ore body as it exists in the ground. It is not currently possible to completely recycle mineral resources; it it may never be. However, before the mineral resource in the ground is irretrievable and totally depleted, it may be possible to slow the overall depletion of mineral resources to a point where they only need be replaced when they are destructively used.

The rate at which the depletion of the mineral resource would occur must also be considered in terms of economics and the market values of the mineral commodities involved.

2. Energy Resources

The proposed mining of vermiculite and the reclamation of disturbed areas at the proposed mine site would require the use of liquid fuels in the form of diesel fuel and gasoline, and structural and repair materials. This power would be irretrievably consumed. In addition to fuel, an unquantifiable amount of chemicals and materials used in the subsequent reclamation processes would also be irretrievably lost for other uses.

3. Terrestrial Fauna

The irreversible and irretrievable commitments of the wildlife resource of the area is difficult to address for a single proposed development. Impacts from the proposed West Vermiculite development, as well as the impacts from all other present and future developments throughout the area would probably have a synergistic effect upon the sum of the impacts from individual developments.

4. Human and Economic Resources

The capital investment in plant and productive equipment at the mining termination is irretrievable and irreversible once committed, if no alternate usage can be found. Labor invested in construction and in mining ore is irretrievable once expended, but the labor commitment is reversible should a premature termination occur.

Such an investment and commitment of human and economic resources is required for any economic activity. But unless the venture fails, this is a beneficial and necessary application of resources to create new employment and new sources of personal income.

5. Archaeological and Historical Sites

Archaeological and historical resources are nonrenewable. In the event that significant sites are discovered and enforcement of regulation is inadequate, archeological and historical resources could be irretrievable lost. In addition To the loss of physical resources, educational and scientific information regarding prehistoric environments and our natural and cultural heritage could also be lost.

IV. MITIGATING OR COMPENSATING MEASURES

Three basic types of mitigating measures have been recognized as relative to the Western Vermiculite project proposal. They are: (1) measures required by Local, State, or Federal laws, regulations, or executive orders; (2) measures proposed by Western Vermiculite as part of their mining and reclamation plan; and (3) other measures generally thought to have merit by the EIS task force. The first two categories include those measures that are binding upon Western Vermiculite and must be implemented upon approval of the proposal and issuance of the various agency permits associated with the mining proposal. By attachment of stipulations, other measures comprising the third category may be required as part of the companies' reclamation plans in those instances where the permitting State or Federal agencies have the authority to do so. Inclusion of these other possible measures in the environmental impact statement affords a practical means of utilizing the expertise of agency members to identify additional measures that, if implemented, would further reduce adverse impacts of the proposal. Inclusion of these other mitigating measures in this statement in no way obligates Western Vermiculite or restricts the decision-making prerogatives of the Federal and State regulatory agencies.

A. Laws and Regulations

1. General Statement

The proposed mining operation must comply with all applicable regulations of Federal, State, and County agencies including:

U.S. Forest Service

U.S. Bureau of Mines

U.S. Environmental Protection Agency

Montana Department of State Lands

Montana Department of Health and Environmental Sciences

Ravalli County, Montana

Regulations enforced by the above agencies are variously designed to assure realization of the full and best interests of the public, to adequately protect the environment, and to achieve continuing highest productive use of the land consistent with surrounding land uses and management objectives.

2. Federal Laws and Regulations

The 1872 mining law grants the miner the right to mine on government land; although this law is still in effect, laws have been passed by Congress that effect but do not diminish the miner's right to mine on government land. These laws and the regulations under which the U.S. Forest Service administers the mining law provide for mitigation of the impacts of mineral development.

The miner must submit for approval an operating plan for his operation prior to doing any work (36 CFR 252.4). Work will not start without the agency having advance knowledge. Approval of the operating plan is contingent upon it meeting the requirements for environmental protection for air quality, water quality, solid waste disposal, fisheries and wildlife, scenic values, road standards and reclamation (36 CFR 252.8). Prior to approval of a large complex or controversial operation the agency can require an environmental statement to assure the concerns of other federal, state and local agencies and the public have been heard and answered (36 CFR 252.5). Basically, this gives the agency the tool to assure that the proposed operation is well planned, environmentally sound and that the concerns of all are heard before any major work begins.

The regulations also cover inspection of the work and facilities for compliance with the approved plan during the development and operation (36 CFR 252.7 and 252.9). Regulations (36 CFR 252.10 and 252.13) provide for reclamation, removal of structures and clean up when operations cease and bonding to insure that this is done.

3. State Laws

Significant State laws for mitigating impacts include:

a. Montana's Hard Rock law defines reclamation requirements necessary for Departmental acceptance of the applicant's reclamation plan, as well as other mitigating measures including accomplishment of specific activities, inspections of mining sites to determine compliance with the reclamation plan, performance bonds, and an annual report of activities by the permittee. The Hard Rock Law is contained in Appendix C.

b. Montana's Clean Air Act (Chapter 39 or Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 1 of Chapter 14, Title 16, Montana Administrative Code) defines air pollution and provides that the Board of Health and Environmental Sciences may prohibit

> *. . .the construction, installation, alteration, or use of any machine, equipment, device or facility which it finds may directly or indirectly cause or contribute to air pollution or which is intended primarily to prevent or control the emission of air pollutants, unless a permit therefor has been obtained from it.*

c. Montana's Water Pollution Control Act (Chapter 48, Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 10 of Chapter 14, Title 16, Montana Administrative Code) charges the Department of Health and Environmental Sciences with the responsibility of regulating water quality by administering a permit system.

d. The State Antiquities Act, (Chapter 25 of Title 81, R.C.M. 1947) which is administered by the Board of Land Commissioners and the Montana Historical Society, provides for the registration and protection of historic, prehistoric, archaeologic, paleontologic, scientific, or cultural sites and objects on State lands. It also provides that the Department is authorized to enter into cooperative agreements with private landowners to preserve, mark, maintain, excavate, or otherwise deal with such sites and objects upon such terms as may be agreed upon.

e. The Montana Resource Indemnity Trust Act (Chapter 70 of Title 84, R.C.M. 1947, and rules adopted thereunder (subchapter 14 of Chapter 14, Title 42, Montana Administrative Code) provides for a tax on mineral production. The taxes are paid into the resource indemnity trust account. The trust account will be allowed to accumulate until it reaches the amount of one hundred million dollars, at which time the legislature is empowered to appropriate net earning and all receipts for improvement of this environment and rectifying damages hereto.

4. Ravalli County Laws

a. Property and Gross Proceeds Taxes

The facilities including equipment and land of the Western Vermiculite project would be subject to a property tax levied by Ravalli County. The proceeds primarily would help fund the Hamilton school district and Ravalli County.

5. Local Ordinances

There are no significant local ordinances that would function to mitigate impacts from the proposed Western Vermiculite mine.

B. Reclamation Plans and Additional Mitigating Measures

The reclamation plan proposed by Western Vermiculite for the project is presented in Chapter One, pages 18 through 22. In addition, the following section contains those mitigating, compensating, or monitoring measures generally thought to have merit. Final design plans for the proposed development will be submitted to the Bitterroot National Forest and the Montana Department of State Lands for review and approval. Approval will be contingent upon meeting all environmental and administrative constraints required by law. Pending agency review of the final engineering and facility designs, site-specific mitigation recommendations beyond a general consideration are not possible.

1. Topography

General mitigation of impacts to existing topography would include:

- Minimization of all cut and fill slopes through proper siting of all facilities to take advantage of existing topography,

- drill or hydroseed and fertilize all cut and fill slopes with seed mixture containing at least two legume species in the first appropriate season following completion of the cutting and filling and,

- terracing of mill waste and mine site to enhance future reclamation efforts.

2. Air Quality

Proposals for mitigating the impacts of the development on air quality involve the control of dust emissions from the mine and mill and reclamation of disturbed areas for the road, mine and mill, etc. The use of the bag house at the mill would be expected to minimize the emissions from the site and revegetation of the disturbed areas would prevent, in large, any of these areas from creating significant particulate problems.

3. Geology

As there would be no significant adverse impact to the geology, no mitigation has been designed for this area.

4. Soils

- Abandoned roads will be ripped to a depth of 16 inches seeded, and fertilized

- stockpiling of the topsoil before mining for reclamation following completion of the mining is not considered mitigation, as additional disturbances of the hillside would be required to store the soil and,

- all topsoil in the areas proposed for the mining and milling be salvaged to its maximum usable depth to allow Western Vermiculite to better meet the stated

goals of the reclamation plan.

5. Water Resources

a. Surface Waters

Those mitigating measures concerning stabilization of disturbed areas described under the Topography section apply to reducing the potential of erosion and sedimentation of surface waters.

b. Groundwater

As no potential adverse impacts were noted to the groundwater no mitigative measures are recognized.

c. Water Quality

Mitigation identified for surface waters above would apply to maintaining the existing water quality.

6. Flora

Re-topsoiled areas would be seeded with a mixture of native grasses. Seeding rates have been chosen that approximate the frequency of native species as well as the expected re-establishment success of planted species.

7. Aquatic Productivity

Mitigation of potential impacts to aquatic productivity is linked closely to the soils resource identified previously. With proper revegetation of the soils on the disturbed areas impacts to aquatic productivity should be mitigated.

8. Terrestrial Fauna

- If it is found that disturbance from the various mining activities adversely affects wildlife at a critical time of year (calving, rutting, etc), that particular activity would be reduced or eliminated for a period of time to reduce the impact to wildlife,

- If expansion of the present mine site is proposed (20 additional acres each year for nine years plus any long-term plans), inspection of these

areas by a wildlife biologist would occur to determine impacts to wildlife and to recommend whether the expansion should actually occur and,

- travel on the Charleys Gulch Road from the Hamilton Heights Road to the processing plant (winter range) would be kept to a minimum from December 15 through May 15 to avoid disturbance to animals on winter range.

- There should be no activity, development, or roads east of Skalkaho Mountain due to the proximity of ideal summer-fall range and large concentrations of elk. Road access into this area would probably displace not only elk, but also mountain goats.

9. Endangered and Threatened Species

Endangered or threatened species are provided with protection by the (U.S.) Endangered Species Act of 1973, and the (State) Nongame and Endangered Species Conservation Act of 1973. In addition, the Bald Eagle is provided protection by the Migratory Bird Treaty of 1918, and the Protection of Bald and Golden Eagles (1940).

10. Social and Economic Resources

As no significant adverse impacts were recognized, no mitigative measures are necessary at this time.

11. Visual Resources

Mitigating measures relating to the visual resource would be required for all mine-related facilities. The design and location of all the facilities would attempt to use topography, vegetative screening, size, shape and color to screen or blend the facility into the landscape. Disturbed areas would be promptly reseeded and restored to vegetation. Areas that were permanently cleared of existing vegetation for the life of the mining project could be shaped to blend in with adjacent natural openings.

V. ALTERNATIVES TO THE PROPOSED ACTION

A. Introduction

Western Vermiculite Company has made separate applications, as required, to the Commissioner of Montana Department of State Lands and the Supervisor of the Bitterroot National Forest for permission and approval of a plan of operation to develop and mine a vermiculite ore deposit near Skalkaho Mountain east of Hamilton, Montana in the Sapphire Mountains.

The vermiculite ore body is located on unpatented mining claims. The mine development will take place on federally owned land. The milling operation will be located entirely on privately owned land.

Given the existing dual regulatory and approval authority regarding the present proposal, the viable and reasonable alternative courses of action available to state and federal agencies for the mine proposal differ significantly. The following discussion of alternatives recognizes the individual responsibilities of the Federal and State governments, and the various alternatives available to the Secretary of Agriculture and to the State authorities.

Alternatives that apply generally to the development of the mineral resources in Montana include those of an administrative nature as well as those involving alternate mining and reclamation plans, technological alternatives, and reduced consumption of energy.

B. Administrative Alternatives Available to the Federal Government

Alternatives available to the Federal government for the proposed action are limited under the existing laws and regulations. The Secretary of Agriculture can:

1. Approve the Operating Plan as Submitted

This alternative certifies that the plan merits environmental standards and any administrative constraints.

2. Require Modification of the Operating Plan to Meet Environmental and Administrative Constraints

This alternative would require a substantial change in the proposed operating plan to meet environmental and administrative constraints. Modification could include changes in the mining and milling methods and/or location of the proposed operation.

Alternatives 2,3, and 4 would require the operator to furnish a reclamation bond (252.8(q) and 252.13) Appendix D. The amount of the required bond would be determined by estimating the cost of stabilizing, rehabilitation and reclaiming the area of operations. During the life of the project should the Plan of operation be modified the bonding requirement would be reviewed and adjusted to conform to the plan as modified.

C. Administrative Alternatives Available to State Agencies

1. Department of State Lands

a. Approval of the Operating Permit for the Life of the Operations

Section 10 (50-1210)(C)(2) of the Hard Rock Law provides that:

> *The operating permit shall be granted for the period required to mine the land covered by the plan and shall be valid until the surface or underground mining authorized by the permit is completed or abandoned, unless the permit is suspended or revoked by the board* as provided in this act. The operating permit shall provide that the reclamation plan may be modified by the board*, upon proper application of the permittee, or department, after timely notice and opportunity for hearing, at any time during the term of the permit and for any of the following reasons:*
>
> *(a) to modify the requirements so they will not conflict with the existing laws;*
>
> *(b) when the previously adopted reclamation plan is impossible or impractable to implement and maintain;*
>
> *(c) when significant environmental problem situations are revealed by field inspectors.*

*Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

(1) Performance Bond

Section 11 (501211) of the Hard Rock Law provides that:

> *The applicant shall file with the department a bond payable to the state of Montana with surety satisfactory to the department in the penal sum to be determinded by the department of not less than two hundered dollars ($200) nor more than twenty-five hundred dollars ($2,500) for each acre or fraction thereof of the disturbed area, conditions upon the faithful performance of the requirements of this act and the rules of the Board.* In lieu of such land the applicant may file with the board* a cash deposit, an assignment of a certificate of deposit, or other surety acceptable to the board.* Regardless of the above limits, the bond shall not be less than the estimated cost to the state to complete the reclamation of the disturbed land. A public or governmental agency shall not be required to post a bond under the provisions of this act. A blanket performance bond covering two (2) or more operations may be accepted by the board.* Such blanket bond shall adequately secure the estimated total number of acres of disturbed land. When determined by the department that the set bonding level of a permit or license does not represent the present costs of reclamtion, the department may modify the bonding requirements of that permit or license.*

No bond filed in accordance with the provisions of this act shall be released by the department until the provisions of this act, the rules adopted thereto and this reclamation plan have been fulfilled.

(2) Suspension of Permit

Section 25 (50-1225) of the Hard Rock Law provides that:

> *If any of the requirements of this act or the rules or the reclamation plan have not been complied with within the time limits set by the department or board* or by this act, the department shall serve a notice of noncompliance on the licensee or permittee, or where found necessary, the commissioner shall order the suspension of the permit. The notice or order shall be handed to the licensee or permittee in person or served by registered mail addressed*

*Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

to the permanent address shown on the application for a permit. The notice of noncompliance shall specify in what respects the operator has failed to comply with this act, the rules or the reclamation plan. If the licensee or permittee, has not complied with the requirements set forth in the notice of noncompliance or order of suspension within the time limits set therein the permit may be revoked by order of the board and the performance bond forfeited to the department.*

b. Denial of the Operating Permit

Section 14.(50-1214) of the Hard Rock Law provides that:

A permit may be denied for any of the following reasons:

(a) The plan of development, mining, or reclamation conflicts with the state water and air purification standards;

(b) The reclamation plan does not provide an acceptable method for accomplishment of reclamation as required by this act.

A denial of a permit shall be in writing and state the reasons therefore.

In addition, Section 15 (50-1215) provides that:

A permit may be denied and returned to the applicant with a request that the application be resubmitted with a different plan for reclamation. The person making application for a permit may then submit to the board a new plan for reclamation.*

2. Montana Department of Health and Environmental Sciences

a. Air Quality Bureau

(1) Approval of the Construction Permit

MAC 16-2.14(1)-S1400(3) of the departmental rules and regulations adopted pursuant to the Montana Clean Air Act (Title 69, Chapter 39, R.C.M. 1947) provides that:

The application for a permit shall be accomplished by plans, specifications, and such other information as the administrator deems necessary except that the

*Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

administrator may dispense with the submission of plans and specifications upon prior written agreement.

S1400(ii) further states that:

Before any article, machine, equipment or other contrivance described in this regulation may be operated or used, a written permit shall be obtained from the administrator. No permit to operate or use shall be granted by the administrator for any article, machine, equipment or other contrivance described in this regulation, constructed or installed without authorization as required in this regulation until the information required pursuant to these regulations is presented to the administrator and such article, machine, equipment or contrivance is altered, if necessary, and made to conform to the standards set forth elsewhere in the standards and regulations formulated under authority of the Clean Air Act of Montana.

(2) Denial of the Construction Permit

MAC 16-2.14(1)-S1400(12) provides that:

The administrator shall deny an authority to construct, or permit to operate or use, except as provided in this regulation, if the applicant does not show that every article, machine, equipment or other contrivance, the use of which may cause the issuance of contaminants, or the use of which may eliminate or reduce or control the issuance of air contaminants, is so designed, controlled, or equipped with such air pollution control equipment, that it may be expected to operate without emitting air contaminants in violation of standards and regulations formulated under authority of the Clean Air Act of Montana.

In acting upon a permit to operate, if the administrator or a member of his staff finds that the article, machine, equipment or other contrivance has not been constructed in accordance with the authority to construct, he shall deny the permit to operate. The administrator shall not accept any further application for permit to operate the article, machine, equipment, or other contrivance so constructed until he finds that the article, machine, equipment or other contrivance has been constructed in accordance with the authority to construct.

(3) Conditional Approval of the Construction Permit

MAC 16-2.14(1)-S1400(13) provides that:

The administrator may issue an authority to construct or to operate or use, subject to conditions which will bring the operation of any article, machine, equipment or other contrivance within the standards of this regulation, in which case the conditions shall be specified in writing. Commencing work under such an authority to construct or operation under such a permit to operate shall be deemed acceptance of all the conditions so specified. The administrator shall issue an authority to construct or a permit to operate with revised conditions upon receipt of a new application, if the applicant demonstrates that the article, machine, equipment or other contrivance can operate within the standards of this regulation under the revised conditions.

(4) Renewal of Construction Permit

MAC 16-2.14(1)-S1400(7) provides that:

(7) If the construction, installation or alteration for which a permit has been issued is not completed within two years from the date of issuance of the permit, a renewal of the permit shall be required.

D. Alternative Technology

(1) Underground Mining

The vermiculite ore body is not an isolated subsurface deposit; rather, it occurs as a surface outcrop. Therefore, subsurface mining is not a viable alternative.

(2) Wet Process Beneficiation

This process is employed to control dust and is a closed-loop system utilizing settling ponds to recycle the water.

This form of processing would require additional disturbance to the area for construction of the settling pond. There would also be the requirement of water for operation.

Wet processing would present possible problems with settling pond failure and possible increased erosion and downstream sedimentation.

(4) Vermiculite Production Rates

The proposed mining plan calls for a mining rate of 50,000 tons per month. A lower mining rate would result in less land disturbed at any one time and thus a lesser environmental impact each year. However, to produce the same total amount of vermiculite from the mine, the duration of impact would be extended. Less production would also mean reduced employment and annual royalty income to the Department of State Lands and less tax revenue to federal, state and local governments.

Increasing the rate of production would result in an accelerated rate of land disturbance, higher employment levels, additional vehicle and rail traffic and an acceleration in the rate of environmental impacts previously discussed. There would also be larger annual royalty payments, higher payrolls, and increased tax revenues if production increased. The total duration of impacts would be shortened accordingly.

VI. CONSULTATION AND COORDINATION WITH OTHERS

A. Development of Statement

This environmental impact statement was prepared by a Federal-State task force under the co-leadership of the Bitterroot National Forest and the Montana Department of State Lands. Major inputs were provided by the following:

Federal Agencies

U.S. Forest Service - Bitterroot National Forest

State Agencies

Montana Department of Health and Environmental Sciences

Montana Department of Fish and Game

Montana Department of Community Affairs

Montana Office of the Superintendent of Public Instruction

Montana Department of State Lands

Private Organizations

Western Technology and Engineering Inc.

Additional participation and assistance were obtained from many sources. Western Vermiculite Company provided data and information on their proposed activities which was of great help.

B. Review of Statement

In accordance with U.S. Council of Environmental Quality and Montana Department of State Lands' rules and guidelines, copies of the draft statement are being made available to the public for their comments and suggestions.

Literature Cited

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APPENDIX A

(1AB) High Ridges and Gentle Slopes

These lands generally occur between 6,500 and 8,800+ feet on the east side and West Fork, and 6,800 to 8,800 feet on the east face of the Bitterroot Range. Their soils are deep, well drained, light olive brown to yellowish brown, cobbly, textural groups A through B, with a coarse fragment content from 40-60 percent. They overlie quartzite, limestone, and quartzitic argillite at depts of 6 to 10 feet. On occassion, a reddish brown sandy loam to silt loam horizon occurs near the surface. This horizon is very friable and of somewhat higher fertility than the remainder of the profile. Slope gradients range most commonly from 20 to 50 percent. These soils are moderate to low in fertility and usually have a moderately low water holding capacity with a high infiltration and permeability rate.

(2AW) Imperfectly Drained

These lands occur between 6,600 and 7,000 feet on the Sula District. The significant difference from the typical or modal land type (No. 2), is the internal drainage. This results from lateral movement, both on the surface as well as subsurface, of seasonal moisture. A general concave surface occurs in these units. This off-drainage is not related to a water table.

(3A and 3A1) South Slopes

These lands generally occur between 6,500 and 8,600 feet on the east side and West Fork, and 6,400 to 7,800 feet on the east face of the Bitterrot Range. Their soils are deep, well drained, yellow to brownish yellow, cobbly, textural group A through C, with a coarse fragment content from 40-60 percent. They overlie quartzite, limestone, and quartzitic argillite at depths of 2 to 6 feet. The A horizon is very friable and somewhat higher fertility than the remainder of the profile. Slope gradients range from 40 to 60 percent.

Above 7,000 feet in the vicinity of Razorback Ridge and Deer Creek, this

unit is underlain with granitics and rhyolite. The depth varies from shallow to moderately deep and the coarse fragement content is lower, 10 to 20 percent by volume.

These soils are moderate to low in fertility and usually have a moderately low water holding capacity with a high infiltration and permiability rate.

(12A and 12A5) Cool North Slopes

These lands occur in a range of elevation from 6,000 to 7,600 feet on the east side and West Fork, and 6,000 to 6,800 feet on the east face of the Bitterroot Range.

Soils on these lands are deep, well drained, yellowish brown to dark yellowish brown, cobbly, textural groups A and B, with a coarse fragment content from 40 to 60 percent by volume. They overlie granitic and rhyolite rocks. Depth to bedrock is 4 to 6 feet. A thin reddish brown sandy loam to silt loam horizon may occur near the surface of this landtype. Slope gradients range from 40 to 60 percent. Fertility of these soils varies with the parent rock and soil texture. Textural group A is low in fertility. . . Soil moisture stress is less severe than on Unit 10 (warm north slopes) due to cooler temperatures.

(14) Cool South Slopes

These lands occur in a range of elevation from 6,000 to 7,600 feet on the east side and West Fork, and 6,400 to 7,000 feet on the east face of the Bitterroot Range. Soils on these lands are deep, well drained, brownish yellow to yellowish brown, cobbly, textural groups A through C with a coarse fragment content from 40 to 60 percent by volume. They overlie granitic and rhyolite rocks on the A textural group, and the volcanics on the C textural group. Depth to bedrock is 4 to 6 feet. A thin, reddish brown, sandy loam to silt loam horizon may occur near the surface of this landtype. Slope gradients range from 40 to 60 percent.

Fertility of these soils varies with the type of parent rock and soil texture. Textural group A is low in fertility, group B is moderate, and group C is moderately high. Soil mosisture levels available for tree growth would show about the same relationship, i.e., increasing from group A to C.

(11A1) Very Shallow South Slopes

These lands are on south aspects, very steep slopes, and usually occur adjacent to the major streams in the area. They occur between 4,200 and 7,600 feet on the east side and West Fork, and 3,500 to 6,800 feet on the east face of the Bitterroot Range. Their soils are shallow to very shallow, well drained, yellow to brownish yellow, cobbly, textural group A, with a coarse fragment content of from 40 to 60 percent by volume. They overlie granitic and Belt rocks. Slope gradients range from 40 to 70 percent.

(22) Navationally Scoured uplands

This landtype occurs as depressions or hollows near ridgetops of strongly frost-churned uplands. It is assumed to have formed largely by intense frost action and localized ice movement. Some areas appear as weakly formed "amphi-theatres" where snow patches dug themselves in. The hollows are concave with slope gradients ranging from 30 to 60 percent. The landtype is generallly located on north and east slopes or on the south and west aspects opposite glacial cirque walls. They adjoin strongly frost-churned upland landtypes. They are normally found at elevations above 6,500 feet.

(22A) Moderately steep (30 to 50 percent slopes), slightly concave slopes on the south and west exposures. The major rocktypes are granite and gneiss.

The soils are well drained, 1 to 3 feet thick with 3 to 6 inches surface layers of wind deposited (loess) loam. The subsoil is gravelly sandy loam or gravelly micaceous sandy loam containing 30 to 50 percent granitic rock with sandy textured soil in the inersticies.

The most serious limitations to use are the steep slopes which limit vehicle use and cold climates which limit timber production on upper slopes. These are deep snow accumulation areas. Erosion from disturbed sites is moderate. Mass failure potential is moderate.

Soil classification: Typic cryochrepts, loamy skeletal, mixed Lithic cryochrepts, loamy skeletal, mixed

(22A1) This unit is very similar to 22A except 10 to 20 percent of the area is rock outcroppings and the soil depths are mostly 1 to 2 feet.

The most serious limitations to use are the steep slopes which limit vehicle use and the shallow soil depths which restrict rooting depths and water holding capacities.

Soil classification: Lithic cryochrepts, loamy skeletal, mixed.

(25) Glacial Trough Wall (with soil)

The lands of this unit occupy the sideslopes of the U-shaped trough typical of alpine glaciated mountains. This unit occurs between 6,400 and 7,200 feet on the east side and West Fork, and 4,200 to 8,000 feet on the east face of the Bitterrroot Range. Slope gradients range from 60 to 80 percent. The soils of this unit are shallow, excessively drained, very pale brown to yellowish brown, gravelly or cobbly with a coarse fragment content of 50 to 70 percent by volume.

(46A) Glacial Till

This land type is an unstratified, unconsolidated, heterogeneous mixture of sand, silt, clay, gravel, and boulders. It is found at 6,000 to 7,600 feet on the east side and West Fork, and 4,000 to 6,800 feet on the east face of the Bitterrot Range. Most of these deposits are lacking in any significant amount of clay. Slope gradients range from 20 to 50 percent. This landtype is commonly susceptible to revealing of cutbanks for road construction. Revegetation of the

cuts is very difficult as a result of the raveling and poor soil-mositure relationship.

APPENDIX B

Canopy coverage/average frequency of occurrence of low growing plants on elk winter range transect sites, Hunting District 261, 1974 and 1975a.

	Transect Sites								
	N. Birch Creek	Willow Creek	BRGR T-1	BRGR T-2	BRGR T-3	Eastman Creek Hill	Mtn. House	St. Clair Ridge	Newton Gulch
Bare soil	27/95	18/85	17/90	11/70	10/75	26/90	7/70	18/90	48/100
Rock	5/70	5/70	2/20	1/5	3/35	3/45	10/35	tr/55	3/35
Erosion pavement	2/10	tr/10	1/20	tr/5	5/55	7/50	6/35		
Litter	35/100	44/100	26/95	42/95	28/95	19/100	3/90	36/100	23/95
Moss		8/45	6/40	29/85	8/90				
Grass and grass-like speicies									
Agsp Bluebunch wheatgrass	25/85	3/20	7/50	17/55	13/70	9/85	10/50	9/50	23/95
Brte Cheatgrass	3/20		7/40	7/35	4/40		10/40		tr/5
Carex Spp. Sedge		1/5		tr/5			tr/10		
Feid Idaho fescue	6/45	2/15	10/65	1/15		10/95	2/25	17/100	
Fesc Rough fescue		8/45	2/15	4/20		4/10	tr/5	6/55	
Kocr Prarie junegrass	1/25	4/45	3/55	2/30	14/95	9/90	6/60	5/75	11/95
Poa spp. Bluegrass	9/85	5/60	5/65	7/75	1/55	10/90	11/70	6/55	9/100
Stco Needle and thread	4/25	7/50		5/25	tr/10		6/35		tr/5
Unidentified grasses			1/5						
Total	47/95	30/50	35/100	45/100	32/100	42/100	45/100	43/100	43/100

APPENDIX B

	N. Birch Creek	Willow Creek	BRGR T-1	BRGR T-2	BRGR T-3	Eastman Creek Hill	Mtn. House	St. Clair Ridge	Newton Gulch
Forbs									
Acmil - Farrow	1/10	12/75	3/45	12/75	tr/5	3/55	5/45	6/70	3/35
Affl - False dandelion						1/5			
Allium spp. - onions	1/3		tr/15			tr/15			
Antennaria spp. - Pussytoes	1/20	7/30	1/20		tr/5	tr/10	1/30	1/25	tr/5
Apanp - Doglove						1/5			
Arco2 -Arnica	3/40	tr/5	tr/15	1/20		2/40	tr/10	4/65	2/40
Arse2 -				7/85	15/55	2/20		1/5	tr/5
Arfr - Fringed sagework	2/15		1/5	tr/15	2/15		2/20		
Aster spp. - Asters							2/o	4/40	
Astragalus spp. - Vetch					9/70		1/5		
Basa - Arrowleaf balsamroot	3/10	3/10			9/30	5/25			
Cema2 - Krapweed		tr/5	10/55						
Cirsium spp. - thistle							tr/10		
Unk. composite		2/15	2/20	1/20		2/20	1/5	1/10	3/25
Unk. Cruciferae - Mustard	tr/10		2/5		2/55	1/35	5/60	5/70	9/95
Doco - Shooting star						tr/5			
Erigeron spp. - Fleabame		2/10		tr/5	3/30	tr/5	2/10	tr/1	1/20

APPENDIX B

	N. Birch Creek	Willow Creek	BRGR T-1	BRGR T-2	BRGR T-3	Eastman Creek Hill	Mtn. House	St. Clair Ridge	Newton Gulch
Erum - Buckwheat	2/10			tr/5		Tr/5	tr/5		
Ergr1 - Fleabane	tr/5								
Frivi - Virginia Strawberry		1/20	1/15						
Gaar - Gaillardia	tr/10		1/25						
Getr - Prarie smoke				tr/5				tr/5	
Gevi - Sticky Geranium							tr/5		1/5
Grindelia spp. - gremweeds							2/15		
Hieracium spp. - Hawkweed		2/20				2/40		1/5	tr/5
Livu - Butter & Eggs			tr/5						
Liru - West gromwell						tr/5			
Losi - Lomatium		tr/10		tr/10					
Lupinus spp. - Lupine	5/25					1/15	1/20	2/20	
Mertensia spp. - Bluebell					tr/5				
Oppo - Plours prickley pear					tr/5				
Orte - Lousewort	2/25		5/60	6/50		5/70	2/30	2/50	
Pipa -					1/30				
Rumex spp. - Curly dock cleft leaf	1/5	1/5	tr/10						
Sest - Groundsel			1		1/5				
Senecio spp. - groundsel									tr/5

APPENDIX B

	N. Birch Creek	Willow Creek	BRGR T-1	BRGR T-2	BRGR T-3	Eastman Creek Hill	Mtn. House	St. Clair Ridge	Newton Gulch
Solidago spp. - goldenrod	1/10	4/34				5/25	3/25	6/45	2/25
Taof - Common dandelion		1/25	tr/10			tr/15	tr/15	tr/15	tr/5
Trdu - Yellow salsify	tr/10	tr/10	tr/10	3/30	1/20		tr/5	tr/10	
Vicia spp. - Vetch			2/15						
Zygadenus spp. - Death comas						tr/10		1/25	
Unidentified	3/50	1/20	7/5		tr/5	2/40	3/30	2/55	2/40
Total	26/95	36/100	36/100	30/100	42/100	33/100	30/100	36/100	23/100

APPENDIX B

	N. Birch Creek	Willow Creek	BRGR T-1	BRGR T-2	BRGR T-3	Eastman Creek Hill	Mtn. House	St. Clair Ridge	Newton Gulch
Browse									
Artr - Big Sage	5/10	3/15					1/5		
Bere - Oregon grape		1/5							
Chna - Rubber rabbitbush			1/5					tr/5	
Rosa spp. - Rose		1/5							
Syal - Snowberry		3/10							
Teca - Wood sage					1/5				
Unidentified				2/10					
Total	5/10	8/30	1/5	2/10	1/5		1/5	tr/5	

a Provided by John Firebaugh, Montana Fish and Game Department

b Abbreviations from Plummer, Monsen and Stevens (1977).

APPENDIX C
Birds of latilong 26 (including mine area).[a]

Species[b]	Breeding Status[c]
Gaviiformes	
Common loon	b
Podicipediformes	
Red-necked grebe	B
Horned grebe	t
Eared grebe	b
Western grebe	t
Pied-billed grebe	b
Pelecaniformes	
White pelican	t
Ciconiiformes	
Great blue heron	B
American bittern	b
Anseriformes	
Whistling swan	t
Trumpeter swan	b
Canada goose	b
Snow goose	t
Ross' goose	t
Mallard	B
Gadwall	b
Pintail	b
Green-winged teal	B
Blue-winged teal	B
Cinammon teal	B
American widgeon	B
Northern shoveler	t
Redhead	B
Ring-necked duck	t
Canvasback	B
Greater scaup	?
Lesser scaup	B
Common goldeneye	t
Barrow's goldeneye	t
Bufflehead	t
Oldsquaw	t
Harlequin duck	B
Ruddy duck	b
Hooded merganser	t
Common merganser	B

Appendix C (cont.)

Falconiformes	
Turkey vulture	b
Goshawk	B
Sharp-skinned hawk	b
Cooper's hawk	B
Red-tailed hawk	B
Swainson's hawk	B
Rough-legged hawk	t
Golden eagle	b
Prairie falson	B
American kestrel	B
Galliformes	
Blue grouse	B*
Spruce grouse	B*
Ruffed grouse	B*
White-tailed ptarmigan	?
Sharp-tailed grouse	b
Ring-necked pheasant	B
Chukar	b
Gray partridge	B
Turkey	B
Gruiformes	
Sandhill crane	t
Sora	B
American coot	B
Charadriiformes	
Senipalmated plover	t
Killdeer	B
Common snipe	B
Long-billed curlew	B
Upland sandpiper	b
Spotted sandpiper	B
Solitary sandpiper	t
Willet	t
Greater yellowlegs	t
Lesser yellowlegs	t
Semipalmated sandpiper	t
Marbled godwit	t
American avocet	b
Wilson's phalarope	b
Long-tailed jaeger	t
California gull	b
Ring-billed gull	t
Bonaparte's gull	t
Common tern	t
Black tern	B

Appendix C (Cont.)

Columbiformes	
Band-tailed pigeon	t
Rock dove	B
Mourning dove	B
Strigiformes	
Barn owl	?
Screech owl	t
Great horned owl	b
Pygmy owl	b
Barred owl	t
Great grey owl	t
Long-eared owl	b
Short-eared owl	b
Saw-whet owl	t
Caprimulgiformes	
Poorwill	b
Common nighthawk	B*
Apodiformes	
Vaux's swift	B
White-throated swift	B
Black-chinned hummingbird	B
Anna's hummingbird	t
Broad-tailed hummingbird	t
Rufous hummingbird	B
Calliope hummingbird	B
Coraciifirmes	
Belted kingfisher	B
Piciformes	
Common flicker	B
Pileated woodpecker	b*
Lewis' woodpecker	B
Yellow-bellied sapsucker	B
Williamson's sapsucker	B*
Hairy woodpecker	B
Downy woodpecker	B
Black-backed three-toed woodpecker	b
Northern three-toed woodpecker	b
Passeriformes	
Eastern kingbird	B
Western kingbird	B
Ash-throated flycatcher	t
Says's phoebe	B
Willow flycatcher	B
Least flycatcher	b
Hammond's flycatcher	B*

Appendix C (cont.)

Dusky flycatcher	B*
Western flycatcher	b
Western wood pewee	B
Olive-sided flycatcher	b
Horned lark	B
Violet-green swallow	b
Tree swallow	B
Rough-winged swallow	b
Barn swallow	B
Cliff swallow	B
Purple martin	t
Gray jay	b*
Blue jay	t
Steller's jay	b
Black-billed magpie	B
Common raven	b
Common crow	b
Pinon jay	t
Clark's nutcracker	B
Black-capped chickadee	B
Mountain chickadee	B*
Chestnut-backed chickadee	t
White-breasted nuthatch	b
Red-breasted nuthatch	B*
Pygmy nuthatch	t
Brown creeper	b
Dipper	B
House wren	B
Winter wren	b
Rock wren	b
Gray catbird	B
Sage thrasher	t
American robin	B*
Varied thrush	b
Hermit thrush	B*
Swainson's thrush	B*
Veery	B
Western bluebird	B
Mountain bluebird	B
Townsend's solitaire	B*
Golden-crowned kinglet	b*
Ruby-crowned kinglet	b*
Water pipit	B
Bohemian waxwing	t
Cedar waxwing	B
Northern shrike	t
Loggerhead shrike	b

Appendix C (cont.)

Starling	B
Solitary vireo	B*
Warbling vireo	B*
Orange-crowned warbler	B
Nashville warbler	b
Yellow warbler	B
Yellow-rumped warbler	B*
Townsend's warbler	B
Blackpoll warbler	t
Northern waterthrush	b
Macgilivray's warbler	B
Yellow-breasted chat	b
Wilson's warbler	b
American redstart	B
House sparrow	B
Bobolink	B
Western meadowlark	B
Yellow-headed blackbird	B
Red-winged blackbird	B
Northern oriole	b
Rusty blackbird	t
Brewer's blackbird	B
Brown-headed cowbird	B
Western tanager	B*
Black-headed grosbeak	B
Indigo bunting	t
Lazuli bunting	B
Evening grosbeak	B*
Purple finch	t
Cassin's finch	B
House finch	B
Pine grosbeak	b
Gray-crowned rosy finch	b
Black rosy finch	B
Common redpoll	t
Pine siskin	B*
American goldfinch	b
Red crossbill	B
White-winged crossbill	t
Rufous-sided towhee	b
Lark bunting	t
Savannah sparrow	B
Vesper sparrow	B
Lark sparrow	b
Dark-eyed junco	B*
Gray-headed junco	t
Tree sparrow	t
Chipping sparrow	B*

Appendix C (cont.)

Brewer's sparrow	b
Harris' sparrow	t
White-crowned sparrow	b
Golden-crowned sparrow	t
White-throated sparrow	t
Fox sparrow	b
Lincoln's sparrow	b
Song sparrow	B
Lapland longspur	t
Snow bunting	t

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[a] From Skaar (1975)

[b] Nomenclature from American Ornithologists Union (1975) and Skaar (1975)

[c] B = hard evidence of breeding

b = only circumstantial evidence of breeding

t = occurs, but no evidence of breeding

? = only questionable records

* = coniferous breeder (Manuwal, 1968)